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DESERT
SHIELD/STORM

LOGISTICS LESSONS LEARNED

FRONT COVER: Senior Airman Damien Hebert, England AFB, hot pitting an A-10 during Operation Desert Storm. (Photo courtesy of Capt Melroy)

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SPECIAL: AFLMC NICHES ITS WAY INTO DESERT SHIELD/STORM HISTORY

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AFLMC NICHES ITS WAY INTO DESERT SHIELD/STORM HISTORY

The overall mission of the Air Force Logistics Management Center (AFLMC), Gunter AFB, Alabama, is to work Air Force logistics problems, improve Air Force logistics war-winning capability, and shape tomorrow's logistics environment.

To achieve these goals, Center personnel must carefully analyze and study data, and then recommend new or improved concepts or procedures. Anyone can submit project proposals to the Center.

On 2 August 1990, when the Iraqis invaded Kuwait, the Air Force was able to respond to the call for help and performed magnificently throughout the Persian Gulf War. However, as in any war, there were some failures along with the successes. Consequently, the Air Staff requested that the Center collect and analyze data from the different commands and activities to discover how they deployed troops and equipment to the theater. They were also tasked to be the focal point for Air Force logistics lessons learned.

Major Hagel's article discusses the analysis of Desert Shield deployment data and the collection of Desert Shield/Storm logistics data, and then touches on logistics lessons learned. Since there are many more lessons to be released after presstime, the Winter issue of the Journal will include additional lessons in each of the logistics areas (Logistics Plans, Transportation, Supply, Maintenance, and Contracting).

Captain Daly's article presents lessons learned from the standpoint of Supply. The lessons are not all inclusive, but merely a sample of some relevant issues involving supply operations during Desert Shield/Storm.

Capturing Logistics Data

Major Stephen J. Hagel, USAF

Part I

"Those who cannot remember the past are condemned to repeat it."

— George Santayana

On 2 August 1990, a daring blitzkrieg of sorts sailed across the Iraqi border and into Kuwaiti territory. It was over in a matter of hours. Prior to that day, many sabers were rattled on both sides and more than a few were rattled in support of both combatants. The question then was, Would anyone come to the defense of the Kuwaiti plea and the Saudi cry? We know the answer. History tells all. Well, that is, it tells all if the data necessary to tell the story was captured.

The Air Force Logistics Management Center (AFLMC) is assisting in telling that story. We were asked by the Air Staff to look at Desert Shield/Storm from a variety of sources. We currently have several projects in progress to answer some questions about the operation. Many individuals in the field and at the major commands have already had some interaction with us on these projects. Let me tell you about each one and some of the general things we have found so far.

Analysis of Desert Shield Deployment Data

This project, which we are working for the Strategic Air Command (SAC), will attempt to discover how we deployed troops and equipment to the theater. We hope to come out of this study not only with some ways to improve the manner in which SAC deploys but also with some ways to improve deployment across the Air Force. As you might expect when looking into a process such as deployment, we hear many negative things about how it really happened. Perhaps surprisingly enough to some of us, we also hear a lot of innovative ideas or positive comments about the real deployment story.

To capture the picture of how SAC mobilized and deployed, we asked to go to or receive information from some of the SAC bases which played a greater role in the operation. By looking at these bases, we hoped to make inferences to those who perhaps were not tasked with a large deployment, but maybe had a greater support role. We let the MAJCOM choose which bases. We asked for a selection that would include all of the main aircraft—B-52s, KC-135s, and KC-10s. We received those as well as the RC-135s. We visited each of these bases and talked with the folks who worked the deployment. In some cases, we were able to talk to those who worked at both ends of the operation, deploying and employing. They have a different perspective of how well it went too.

There were four objectives in our research, where basically we asked the questions: What did we do right? What did we do wrong? How can we capitalize on the innovations? How can we avoid the pitfalls?

(1) Analyze the deployment data and identify differences between planned and actual deployment data.

(2) Determine to what extent AFR 28-4, *USAF Mobility Planning*, procedures were used.

(3) Compare assets prepositioned at deployed locations or in the area of responsibility to assets tailored from deployment.

(4) Analyze differences and similarities among base/MAJCOM deployment procedures.

As you can see, that is a mouthful. Some of the findings will be subjective; others will have hard data to back them up.

Until the final research is complete, we cannot give you many details; so we will make some general observations. We leaned too far forward in the harness. In most instances, early-on in the

deployment, the units responded with enthusiasm in an attempt to meet those telephonic taskings. Speaking of telephonic taskings, that isn't exactly the way the book says we will conduct our deployments, is it? Normally, we would expect to receive some kind of warning and then be tasked by unit type codes (UTCs) via a time-phased force deployment list (TPFDL) or data (TPFDD). We didn't do well there either. Too many of the taskings came in fragmented UTCs with incomplete information. The TPFDL took several days before it actually was ready for the field to see.

Oddly enough, the story was much the same within the SAC bases. Of course, some would say that is just because SAC deploys that way; however, the story was similar in the Tactical Air Command (TAC), the Military Airlift Command (MAC), and the other commands supplying aircraft and people. At conference after conference, a similar story is told—only the characters are changed to reflect the location.

How do we fix it? Ah, that will have to wait for the next article!

Desert Shield/Storm Logistics Data Collection

This project is an on-going effort to ensure key data elements were preserved for future analytical studies so we can learn from our past successes and failures. The AFLMC was asked to put out a list of what we felt were the most essential logistics data elements necessary to capture the essence of the operation. It was a long list! Logistics is a complicated occupation. We polled our Center to extract what we felt were the key data and sent the message to the MAJCOMs. To keep the effort to a manageable size, we asked each MAJCOM to choose five bases or two bases for each mission design and series (MDS). We then asked the MAJCOMs to store some of the data and the bases to store other portions. In addition, we asked personnel in the field to send the Center still another chunk of the data.

As this project continued, we realized the Historic Research Agency at Maxwell would undoubtedly like to be involved in this project. In fact, they had been receiving data by the box load already. After meeting with them, we arranged a helping agreement, where they would store the information and we would assist in cataloguing and categorizing the data. Again, the purpose of this project was to merely capture the data for future analytical use. Thanks to the efforts of individuals in the field and at the MAJCOM, we are well on our way to doing just that. Yes, we lost some information; but that is to be expected. The end result after years of study will be a better prepared Air Force for the next war.

Analysis of Air Force Desert Shield/Storm Logistics Lessons Learned

If you haven't heard of JULLS or AFLLS (Joint Universal Lessons Learned System or Air Force Lessons Learned System), then now is the time you did. These two systems are really the same. When the AFLMC was tasked to be the focal point for Air Force logistics lessons learned, we discovered the JULLS system already in use. It is a DBase system which is used primarily in the joint world to capture lessons learned from command post exercises and field training exercises; and, oh by the way, this system works for the real world. To keep things easy, we asked the folks who wrote the program if they could change the name for the Air Force version. They obliged us, and now we have AFLLS. The systems work the same and are transparent in the system operation, except for the name. Now, how does it work?

After any exercise or real world operation—and if we are smart and take the time during the operation—pop this diskette in a computer and begin typing in concerns and successes from your experiences with the operation. That is really about all there is to it. From our perspective, the units send their inputs to the MAJCOM who compiles all the inputs including the logistics ones and forwards them to the Air Staff. At the Center, we wanted to receive the logistics lessons learned before everyone had a chance to scrub them, so we asked the MAJCOMs to send us the untouched version. Additionally, we went to the Air Staff to gather any others that may have slipped through. To date, we have over 1000 logistics related lessons learned (unclassified) and over 150 classified lessons. Some of these lessons also fall into other areas, such as TPFDD problems resting in the operations world, but affecting how logisticians do their jobs.

Some of the lessons are noise level lessons. You know, someone complaining about not enough ice in the desert (or was that dessert). Most of them, however, are genuine concerns which need to be fixed before the next war. Sad to say, though, that a good number of them have occurred before and were identified via exercises held in the past. True, many of those are beyond the Air Force's ability to remedy; and, in some instances, Congress is the body who holds the purse strings to solve that problem. Nonetheless, we must continue to identify all of these lessons as they occur, not a year after the fact. Our first lesson learned from this effort is to not wait until the shooting is over and the troops are returning home to launch into a data collection and lessons learned project.

As this project draws to a close sometime in late December, we will release the five most important lessons in each of the logistics functional areas (Logistics Plans (LGX), Transportation (LGT), Supply (LGS), Maintenance (LGM) (to include munitions), and Contracting (LGC)). A complete document will be available through other means. The entire report will have to be classified due to the sensitive nature of some of the lessons. There may be a few surprises, but within each functional area, I'll bet you can guess what at least two of the five will be. See for yourself when they are published in the Winter issue of this Journal.

Those are three of the projects currently in work at the AFLMC which deal directly with Desert Shield/Storm. We appreciate the help in gathering, preserving, cataloging, and conveying the information for these important studies. We also appreciate the time and effort many individuals gave us through interviews in person and over the phone. Their efforts will make a difference in the way logisticians do business in the future, and how we will fight and win the next one.

Keep in mind this one last thought:

> Most official accounts of past wars are deceptively well written, and seem to omit many important matters—in particular, anything which might indicate that any of our commanders ever made the slightest mistake. They are therefore useless as a source of instruction.
>
> —Montgomery of Alamein: Memoirs, xxxiii, 1958.

When all the data is in and the whole story is told, Desert Shield/Storm won't be the exception to this quote. Let's not repeat these same mistakes.

. . . to be continued in next issue

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Supply Lessons Learned

Captain Raymond T. Daly, Jr., USAF

Introduction

War challenges the flexibility of any fighting force. From the standpoint of providing supply support to combat operations, Desert Shield and Desert Storm proved to be no exception. The total amount of weapon systems, manpower, and logistics support funneled into the Persian Gulf surpassed initial expectations. Logisticians found themselves adapting to different demands and developing new methodologies to get the right parts to the right place at the right time to support the flying mission. In a recent interview for *Industrial Engineering*, Colonel Raymond W. Davies, 4th Wing Logistics Group Commander at Seymour Johnson AFB, North Carolina, stated:

> Aircraft in-commission rates averaged over 90 percent or better during both the pre-war and actual 43 day Desert Storm air campaign.[1]

To achieve these rates, enormous effort was expended and many lessons were learned. To gain an accurate perspective from the logistical experiences in the Gulf, we must become aware of how Air Force logistical support was handled in Desert Shield/Storm operations.

Background

The Air Force Logistics Management Center (AFLMC) is playing a significant role in furthering that awareness by collecting and preserving logistics lessons learned from Desert Shield/Storm. Under Air Staff direction, the LMC collected lessons learned from the participating MAJCOMs. As noted in Major Hagel's article (pages 1-2), the Logistics Plans Directorate at the AFLMC has been designated as the Air Force repository for Air Force Desert Shield/Storm Lessons Learned and has been involved in collecting, sorting, and consolidating lessons learned for contracting, logistics plans, maintenance, supply, and transportation. A second project which folds into the LGX lessons learned effort is LS912085 DESERT SHIELD/STORM Supply Lessons Learned. The objective of the supply project is to collect, consolidate, sort, and analyze supply lessons learned. The results of that study will be used by the Air Staff to pass recommendations to the appropriate working groups for problem resolution.

Both projects involved collecting MAJCOM lessons learned and Desert Shield/Storm JULLS inputs and consolidating them into a central database. JULLS is the Joint Universal Lessons Learned System produced by the Department of Defense Training and Performance Data Center (TPDC) in Orlando, Florida. The JULLS system allows DOD personnel to document and track lessons learned. In addition to JULLS inputs, the LMC supply project included interviews with key supply personnel who served in the Persian Gulf or provided direct support from the CONUS. The JULLS documented lessons learned and the interview data for the supply project have been compiled into a compendium which captures and showcases supply related issues identified by participants as lessons worth documenting.

Now, that we've addressed the scope of the project and the source of the data, let's turn our attention to supply lessons learned. The lessons in this article represent selected JULLS data and a sample of the inputs provided to the LMC by the participating MAJCOMs. These lessons are general in scope and primarily focus on Air Force-wide supply support. One thing to keep in mind when reviewing these lessons is that, regardless of whether a lesson is general or specific, big or small, positive or negative, the lesson constitutes someone's perception of a problem from which others can learn. A second point to remember is that, in Desert Shield/Storm, situations sometimes varied depending on location and circumstances, thereby affecting the lesson's application. For example, experiences at bare bases were often quite different than those at locations where an extensive host nation supply infrastructure was in place and geared to support US supply activities. The point here is that, for a lesson to have meaningful application, we must understand its scope and context. The supply lessons in this paper were chosen based on broad application to the Air Force supply system as a whole.

Let's begin by examining the major categories for supply lessons learned as compiled in the LMC study: accountability, asset flow, asset visibility, supply automation, bench stock, communications, chemical warfare defense equipment (CWDE)/mobility gear/weapons, equipment, fuels, host nation support, personnel, planning, replenishment, reconstitution/closeout, retrograde, spares support, uniforms/clothing, and miscellaneous. The miscellaneous category incorporates those lessons that did not neatly fall into one of the primary categories. Examples of topics in the miscellaneous category include facilities, administrative support, retail sales, etc. The fifteen groupings in the LMC study were used to consolidate similar lessons into categories to facilitate analysis and establish a framework for problem resolution.

When looked at in its entirety, Desert Shield/Storm proved to be a tremendously successful logistics operation. Most would agree the key ingredients in the operation were the level of effort, ingenuity, and resourcefulness of our personnel. As recorded in the minutes of a Military Airlift Command deployed Chiefs of Supply conference:

> People, their initiative, assertiveness, ingenuity, and hard work made supply systems and support structures work under extreme adverse conditions.[2]

Lieutenant Colonel Henry L. Taylor, Deputy Commander for Maintenance, 416 Bombardment Wing, Griffiss AFB, New York, in his supply and maintenance lessons learned for an after-action report, remarked:

> . . . the most important lesson learned was really a reaffirmation of the fact that our people represent our most important resource. Competent officers, dedicated NCO's and motivated airmen made this operation work.[3]

Comments such as these reinforce the idea that the human element continues to be a primary resource and a key factor in waging war.

Another factor that influenced how operations were conducted was the location and condition of the deployed sites. Base conditions varied from location to location. Some sites resembled stateside operations; others were forward operating locations (FOLs); and still others consisted of tents and temporary facilities. In some cases, the supply squadrons were fortunate enough to have access to fully constructed warehouses. In other cases, units had to build warehouses or operate out of tents. The point is, the experience differed depending on where personnel were located and what was available.

Planning

Without detailed, accurate, and workable plans, most operations would fail before they even start. For Desert Shield/Storm, logistics planning encompassed establishing a framework and procedures for moving personnel and materials from supporting MAJCOMs into the theater for a unified effort. The planning process called for building up forces to sustain combat operations. Logistically, this incorporated spare parts, equipment, fuels support, replenishment, and prepositioned assets (Harvest Falcon, Harvest Eagle, etc.) as well as other aspects of support. To give an indication of the amount of logistics support involved in a deployment, consider the movement of a single fighter squadron:

> Each 24-plane fighter squadron that deploys requires the equivalent of 20 C-141 airlift cargo loads of up to 70,605 pounds.[4]

Simply stated, it takes planning, airlift, manpower, and timely execution of operations to rapidly move an Air Force combat unit. Desert Shield/Storm deployment sites included 23 primary beddown locations and 3 FOLs. The Air Force moved over 55,000 personnel, 1,200 aircraft, and 26,000 short tons of Harvest Falcon equipment valued at over one billion dollars to these various deployment sites.[5] Harvest Falcon is an air transportable package of hardwall and softwall (tents) shelters and equipment required for housekeeping and aircraft support in bare base conditions.[6]

USCENTAF orchestrated the "Lion's Share" of the Air Force supply support for Desert Shield/Storm:

> The CENTAF mission was to support 1229 deployed aircraft that flew 66,000 combat sorties. Fuels Mobility Support Equipment (FMSE) was the primary refueling mode supplemented by host nation support.[7]

The CENTAF supply mission included the following:

(1) Manage/distribute prepositioned/aggregated war reserve materiel (WRM) supplies and equipment(Harvest Falcon Assets).

(2) Establish/develop supply/fuels policy and procedures for the Area of Responsibility (AOR).

(3) Ensure compliance with prescribed supply/fuels directives.

(4) Coordinate with HQ USAF/CENTCOM/MAJCOMs/deployed wings on supply/fuels issues.

(5) Advise CENTAF/CC/LG on supply/fuels issues.

(6) Support the mission.[8]

To meet these objectives, CENTAF accomplished the following supply tasks:

(1) Sourced/distributed Harvest Falcon equipment to billet/feed/support 55,000 people and 1,200+ aircraft at 23 sites.

(2) Sourced/distributed over 100 R-14 Mobile Hydrant systems/200 R-9 refuelers.

(3) Established fuels operations at all beddown/forward operating locations.[9]

Of course, CENTAF relied on the combined efforts of the contributing MAJCOMs and the deployed forces to accomplish the overall operational goals.

Buildup

The operation required a rapid buildup of forces. Desert Shield began in August 1990 and extended until President Bush's deadline of 15 January 1991. Early deployment called for operating out of War Readiness Spares Kits (WRSK), Mission Support Kits (MSK), and Follow-on Spares Kits (FOSK). Initially, replenishment procedures involved using the Combat Supply System (CSS). Later, supply automation was accomplished with the establishment of the CENTAF Supply Support Activity (CSSA) which connected the deployed supply accounts to a centralized computer at Langley AFB, Virginia. As the war progressed, the number of supply activities in the AOR expanded to 23 accounts.

As the buildup continued, the National Guard and Reserves were called in:

> . . . on Aug. 23, the president invoked, for the first time, the provisions of Section 673b, Title 10, U.S. Code, the Selected Reserve call-up Authority.[10]

Units arriving during the initial stage of the operation typically lived out of their WRSKs for the first 30 days, with follow-on support coming from their home station. The operation then transitioned to the sustainment phase where the supply activity in the AOR supported all of the functions associated with an "up-and-running" supply account. In Desert Shield,

> the sustainment period began as soon as the first aircraft and supply personnel arrived at a site and continued throughout DESERT SHIELD/STORM/CALM to base closure.[11]

In other words, resupply actions were in effect from the start.

Early War

From the supply standpoint, communications in the early phases of a conflict are vital. In some locations, communications were severely limited. There were actual cases where personnel had to wait in line for hours to get an open telephone line or to obtain secure communications. As time went by, communications improved.

Of particular concern during the early portion of the war were resupply and tracking assets in the pipeline. From the first days of Desert Shield throughout the war, keeping assets flowing into the AOR became a primary supply task. Equally important was tracking and ensuring parts arrived at the final destination. During the early stages of the operation, due to the large volume of assets, backlogs occurred at the major ports. To overcome this backlog, the Air Staff established project code 9AU and priority airlift operation called Desert Express.[12] Desert Express was a special MAC channel operation dedicated to flying critical assets from Charleston AFB, South Carolina, to the AOR on a daily basis. For assets going to the AOR from Europe, the Air Staff established European Express. These initiatives provided some relief and contributed to the highly successful mission capable rates of the operational wings.

In terms of spares support,

the initial deployment of the aviation support packages and WRSK worked because the packages were deployed in their entirety; however, follow-on combat supply support activities were riddled with problems.[13]

The Combat Supply System did not work as smoothly as anticipated. Initially, units sent requisition data to the home station via floppy disks. This process resulted in delays and additional workloads. There were also problems with the limited functions the CSS could perform, since it was initially developed for tracking WRSK and obtaining resupply. It was not designed to perform the entire range of supply operations. Therefore, the CSS did not allow for processing equipment transactions, awaiting parts (AWP), and bench stock support.[14]

During the early phases of the deployment, while asset flow problems and backlogs were still being worked out, local purchase saved the day. When asset shortfalls were identified, local purchase was accomplished where possible. Contracting support overall was superb and greatly enhanced mission support.[15]

Long-Term Problems

Even though Desert Shield/Storm can be termed a logistical success, an operation of this magnitude is bound to have some problem areas that require long-term solutions. As long as aircraft fly combat missions and deployed forces require support, supply will wrestle with questions of sustainability:

In fact, as plans were made and implemented to close down each site, logistics support of aircraft operations and general support at each installation continued.[16]

Maintaining accountability has always been a challenge for supply personnel. Throw in the complexities inherent in an operation of the magnitude of Desert Shield/Storm and accountability becomes even more challenging. In addition to the mass quantities of deployed equipment shipped into the Gulf, locally purchased equipment and equipment donated by coalition governments required additional oversight:

Disposition of these assets during closure was unclear (i.e., where to ship, who will account for, etc.). This resulted in equipment items getting shipped to home station without being on equipment records.[17]

As a result, a large additional workload was necessary to account for these assets.

Other problems that caused difficulty were base close-out procedures and lack of guidance for transiting materiel and personnel between border crossings. According to SMSgt John Krueger, the CENTAF/LGS Superintendent in the AOR, "In some places there were no host (nation) agreements for border crossings."[18] When assets backed up at the borders during actual Desert Storm operations, the result was a degradation in mission support. Later, when combat operations ended and close-out operations began, border crossings again were a problem. When it came time to redistribute assets as some sites closed down, items being transferred to other locations were delayed at the borders. As bases completed their operations and aircraft returned stateside, supply personnel were left with the task of resolving issues related to cleaning up and closing out.

Lessons Learned

Not every lesson learned during Desert Shield/Storm had negative connotations; some lessons were very positive. For example, Desert Express was a huge success in expediting movement of critical parts. The CENTAF Supply Support Activity was also successful in enhancing requisition capability and in centralizing problem solving.

There have been many conjectures drawn from Desert Shield/Storm. One thought worth considering was expressed by Colonel Davies in his interview:

Before we enter any future war, it would be a great help to have a better tracking system for supplies and equipment while in transit.[19]

Another point for supply logisticians to remember is that other areas impact the supply process. At a meeting to review Desert Storm supply support conducted at HQ TAC in February 1991, attendees noted that transportation and communications were the most important links in the supply system.[20] Any time a critical link such as transportation or communications is not fully integrated into the logistics support system, the overall process suffers and fails to function as efficiently as it should. Desert Shield/Storm dramatically highlighted the dependence of supply operations upon communications and transportation. Now that we've examined some of the specific lessons, let's look at some of the more generalized lessons.

Asset Flow

Asset flow includes the capability and the logistical mechanisms necessary to move assets to the units that require them. As mentioned earlier, Desert Shield/Storm mandated the rapid mass movement of cargo and personnel. One lesson that clearly stood out was the need for dedicated airlift to move critical assets rapidly to the theater of operations. In this sense, Desert Express was a resounding success. This innovative concept provided the expeditious movement of "showstopper" cargo on a daily basis using dedicated airlift to fly to the Persian Gulf from Charleston AFB. The European Express operation was similar to Desert Express, flying critical European assets to the Gulf on a daily basis. To provide some indication of the impact of these operations, after the inception of Desert/European Express, the average in-transit time for mission capabilities (MICAPs) was reduced from approximately ten to four days.[21]

Another lesson from Desert Shield/Storm was the need to track in-transit cargo and reduce bottlenecks at the ports. Visibility of these pipeline assets was essential to ensure they reached their intended destination in a timely manner. There were numerous occasions where visibility of critical assets was lost en route to the AOR, resulting in additional effort to locate the parts and, in some cases, duplication of effort.[22]

Automation

The lesson learned in automation was that supply needs to be fully automated early on. In the case of Desert Shield/Storm, where deployed supply activities were required to function as fully-up-and-running supply accounts, automation was required but was not available in the initial phases of deployment. Once the automation problem was resolved, the CSSA at Langley AFB became the primary source for requisitioning assets to support the forces in the Gulf. A significant advantage to the CSSA was it served as a single point of contact for problem solving.[23] The establishment of a dedicated computer, communications with the AOR, and a support cell to focus attention on key problems were essential elements of the CSSA concept.[24]

Just as important as the need for automation was the need for connectivity:

> We need connectivity to make the SBSS work in days vs. months after initial deployment - it took approximately 6 months to get real time requisitioning capability at AOR sites.[25]

However, once the CSSA was up and running, real time requisitioning became the standard.

But, even after the sites were tied into the CSSA, there were cases of computer downtime. When computer operations were interrupted, supply technicians found themselves operating by manual post-post procedures and catching up when time and the computer permitted.

Communications

Without effective, reliable in-place communications from the very start, the ability to resupply, work problems, relay information, and provide meaningful support is drastically impaired. The operation further bogs down when secure communications are involved. As mentioned earlier, there were cases where communications capability was limited. Lack of available telephone lines, overly congested message channels, and computer downtime all contributed to restricted supply operations. These problems were more severe during the early stages of the war when access to communication lines was limited. These limitations, however, complicated efforts to secure critical war assets. Colonel Roger Seagrave, CENTAF/LGS in the AOR, voiced his concern over the impact of communications capability on the supply mission:

> Communications was the biggest problem. We need communications in place, so we can plug in and go.[26]

Chemical Warfare Defense Equipment (CWDE)

Chemical Warfare Defense Equipment was another area where valuable lessons were learned. In Desert Shield/Storm, there were numerous cases where personnel deployed without the proper CWDE gear or lost the assets in deployment. Lack of sufficient quantities and problems with control of assets occurred throughout the Gulf War.[27] The result was extensive time and effort spent redistributing CWDE assets in theater. Other factors contributing to the CWDE problem were poor management of assets, prior funding constraints, and lack of centralized control.

Equipment

One of the problems experienced with deployed equipment was it was not always properly accounted for. The major problem was that Chiefs of Supply did not have equipment visibility.[28] There were many reasons for this, but the primary contributing factors were procedural disparities, equipment transfers, redeployment, locally purchased equipment, and the CSS not being geared for equipment transactions. Furthermore, the ability to redistribute equipment was also hampered by lack of asset visibility.

Fuels

In Desert Shield/Storm, fuel was a significant asset. The average daily consumption of fuel in support of Desert Storm was 10.5 million gallons per day.[29] Overall, fuels support was superb. In general terms, accountability and availability summarize fuels lessons learned:

> There were some resupply problems when the Army was unable to meet line haul requirements. This problem was overcome by augmenting line haul with Air Force drivers and donated tank trucks.[30]

In some cases, prepositioned fuels support equipment required maintenance prior to the assets being serviceable. In other cases, additional equipment was needed to support requirements. According to Captain Steve Melroy, a fuels officer who deployed to the Gulf:

> Daily maintenance on fuels vehicles was a must; R-14s held up, but day-to-day maintenance was necessary to keep fuels operations running.[31]

Spares

Desert Shield/Storm spares support was provided through War Readiness Spares Kits (WRSK), Base Level Self-Sufficiency Spares (BLSS), High Priority Mission Support Kits (HPMSK), Follow-On Spares Kit (FOSK), repair, and resupply. There were some instances of shortages, which invariably will be the case in times of budgetary constraints.

During the initial deployment, units had to "live" out of their WRSKs. A point worth noting is, in some cases, maintenance had to cannibalize parts off aircraft remaining stateside to ensure enough spare parts were available to fill the WRSK kits. According to Colonel Davies:

> Had there been more spare parts, it would have saved the 300 plus cannibalization actions necessary to fill our War Readiness Spares Kits (WRSK) prior to deployment.[32]

When looked at in retrospect, spares were not showstoppers. But many actions had to be undertaken that, when added together, highlight the fact that spares availability remains a decisive logistics consideration. The end result was MICAPs (mission grounding situations) were minimized through maintenance actions, Desert/European Express, CSSA resupply efforts, and intensive parts chasing by the base, MAJCOMs, and major supply depots.

Conclusion

Even in an operation as successful as Desert Shield/Storm, there are lessons to be learned. What must be remembered is that these lessons represent a valuable means to analyze the experiences from the Persian Gulf and to improve the overall logistics process to prepare for future conflicts. The lessons presented in this paper are not all inclusive, but merely a sample of some relevant issues involving supply operations. By examining supply operations during Desert Shield/Storm, logisticians have an opportunity to fine-tune the process and ensure the Air Force is prepared when and if another conflict arises.

Notes

[1]Prazak, Steven. IIE Marketing Communications, "Maintenance Operations In Desert Storm: An Interview With Colonel Davies," *Industrial Engineering*, October 1991, pp. 38-41.

[2]Military Airlift Command AOR Supply Conference, 11-13 June 1991, HQ MAC, Scott AFB, Illinois, pp. 1-10.

[3]Taylor, Lt Col Henry L. "Desert Shield/Desert Storm After Action Report," 1702d Consolidated Aircraft Maintenance Squadron, 8 March 1991.

[4]"Dash To the Desert: II, The Race By Air," *Government Executive*, November 1990, pp. 18-22.

[5]Seagrave, Colonel Roger. CENTAF briefing slides, HQ Tactical Air Command, Langley AFB, Virginia.

[6]Burleson, Captain Robert E., and Major Charles S. Johnson. "Supply Wartime Planning and Execution Guide," AFLMC Report LS861050, Air Force Logistics Management Center, Gunter AFB, Alabama (September 1987).

[7]Fuels Management Steering Group Meeting Minutes, HQ USAF, Washington DC, 30 July 1991.

[8]Seagrave, CENTAF briefing slides.

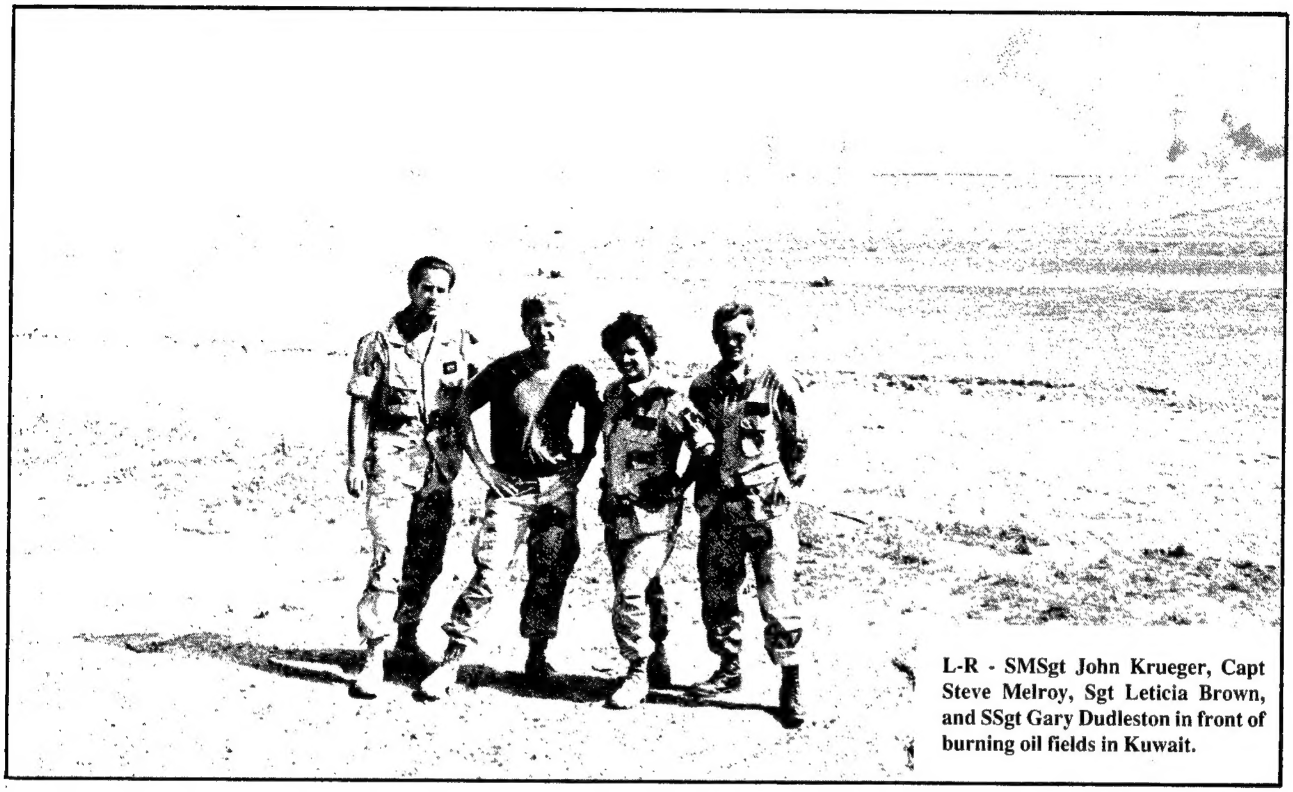
[9]Ibid.

Continued on page 21

PHOTO SECTION

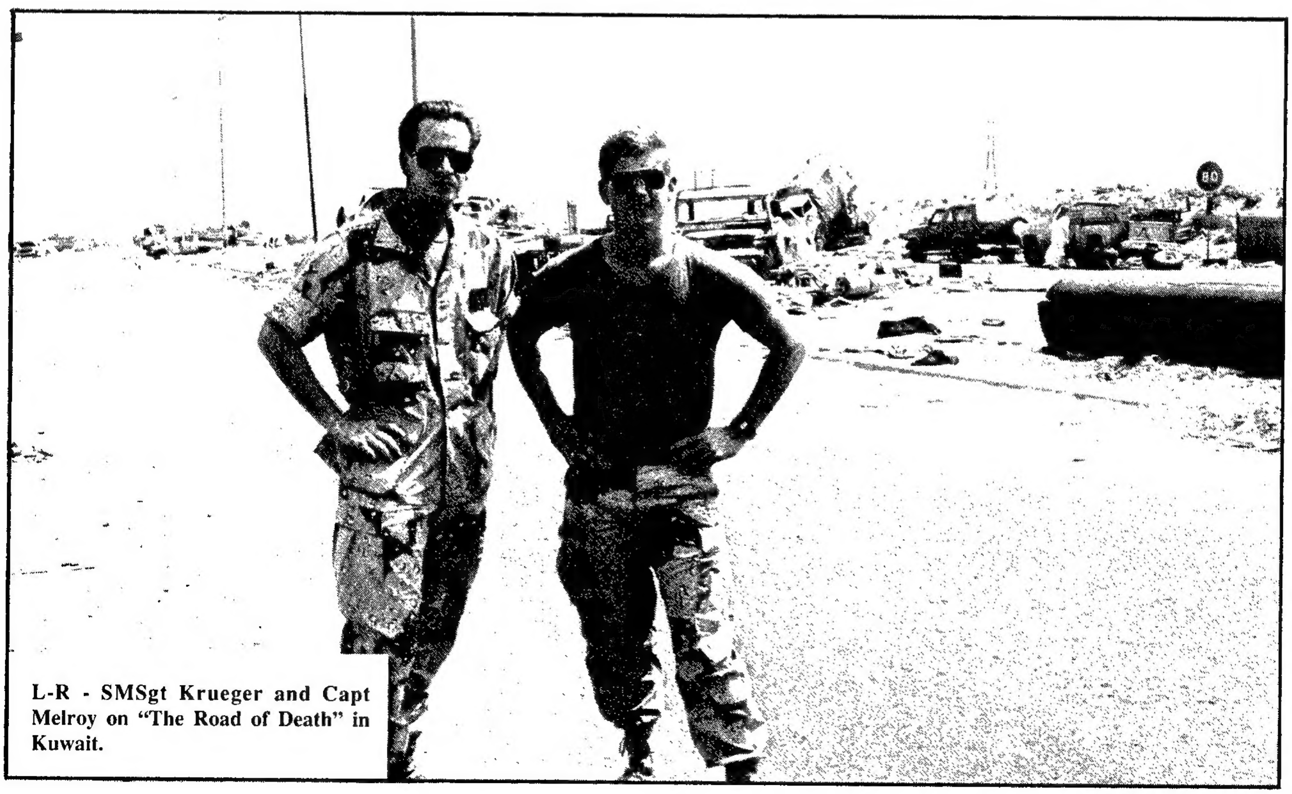
Desert Shield/Storm

BACKDROP OF DESTRUCTION



L-R - SMSgt John Krueger, Capt Steve Melroy, Sgt Leticia Brown, and SSgt Gary Dudleston in front of burning oil fields in Kuwait.

(Photos courtesy of Capt Melroy, 554 Supply Sq, Nellis AFB)

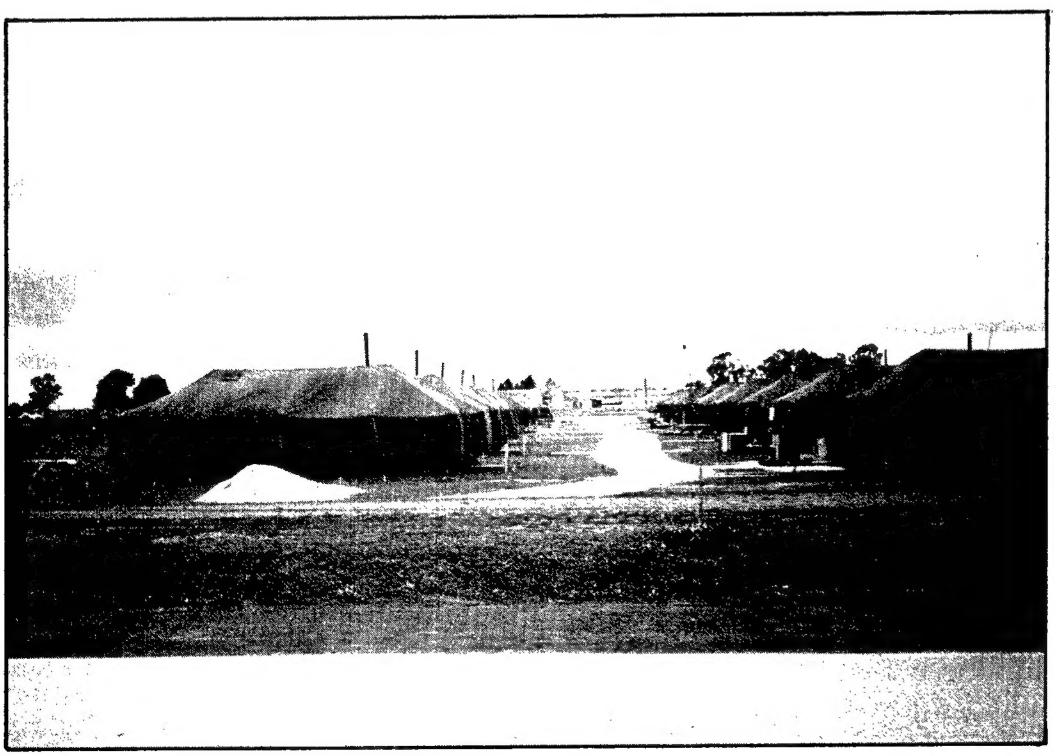


L-R - SMSgt Krueger and Capt Melroy on "The Road of Death" in Kuwait.

LIVING ACCOMMODATIONS

TIGER BEACH

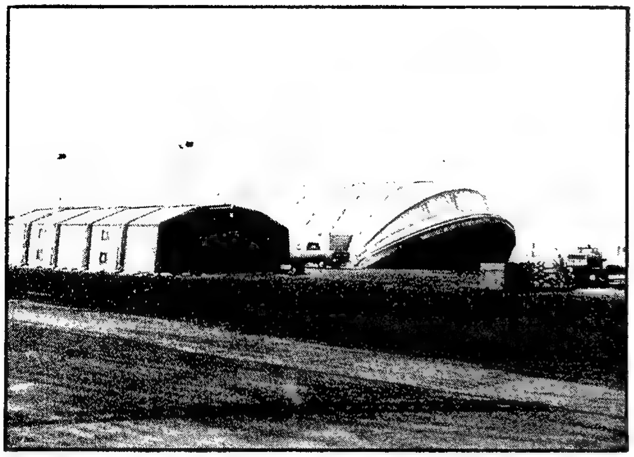
(Courtesy of Capt Melroy)

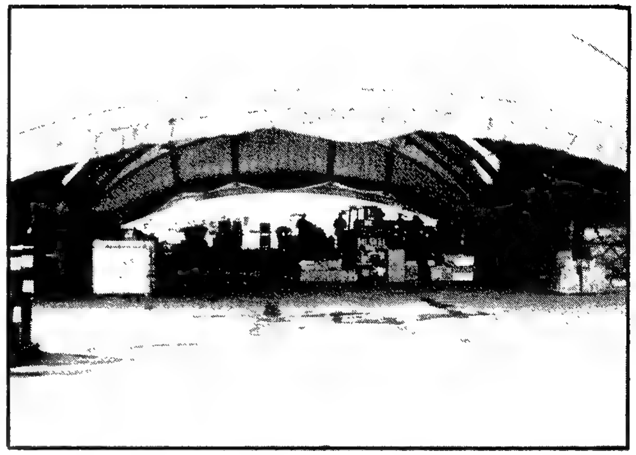


TENT CITY (EUROPE)

(Courtesy of SMSgt Penny Lynn, AFLMC)

SUPPLY PROVIDES LOGISTICS FOUNDATION IN PERSIAN GULF

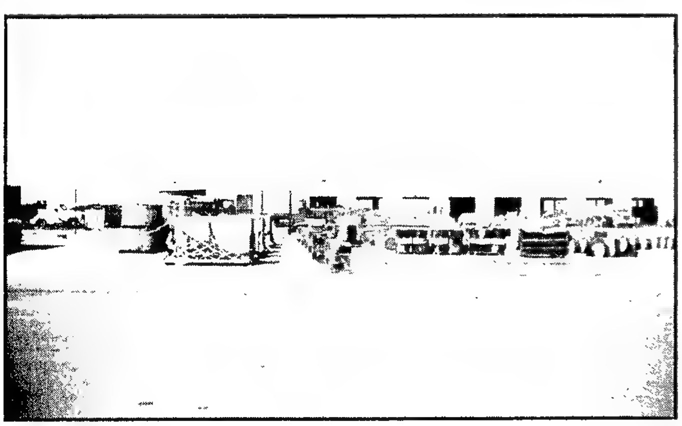




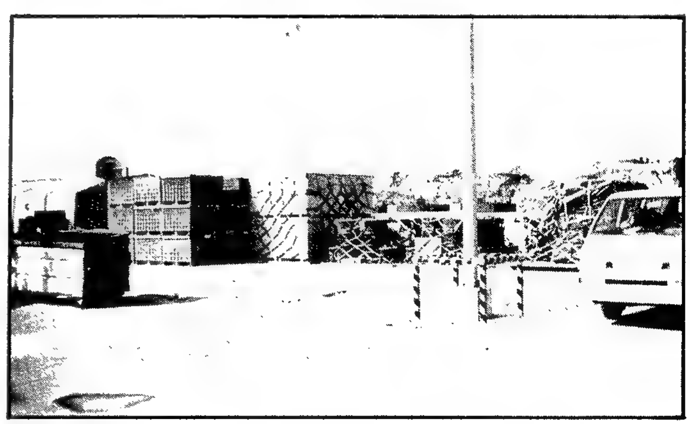
Harvest Falcon general purpose shelters used for housing property (awaiting shipment, etc.).

Forklift in materiel storage & distribution (MS&D) yard in action! Behind 10K forklift is MS&D trailer.

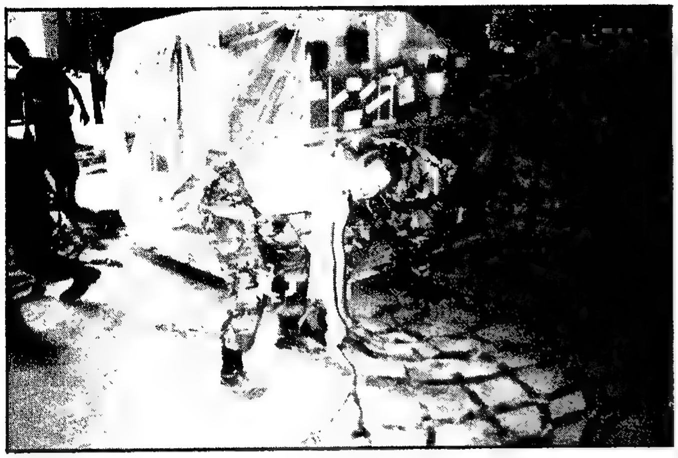
(Photos involve 354 TFW (Provisional) and are courtesy of Capt Melroy)



Receiving overflow yard.

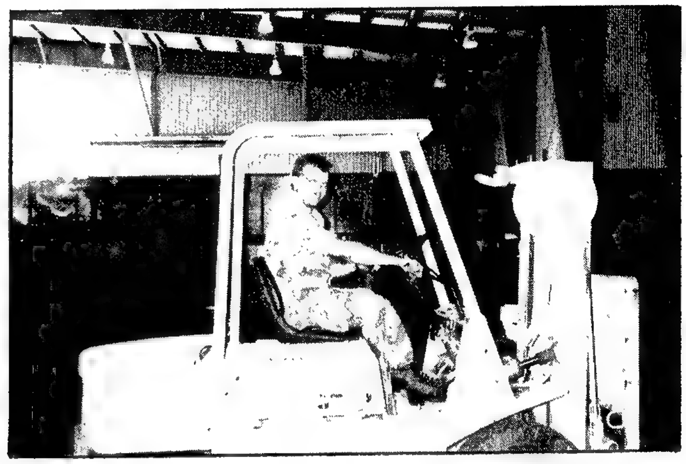


Holding area for mobility bags/miscellaneous items.



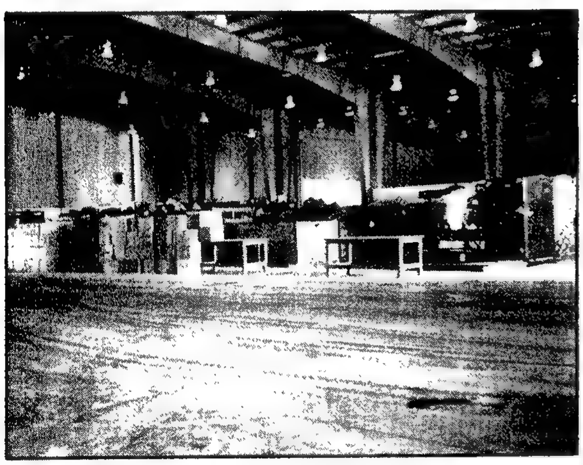
Forklift.

... Warehousing

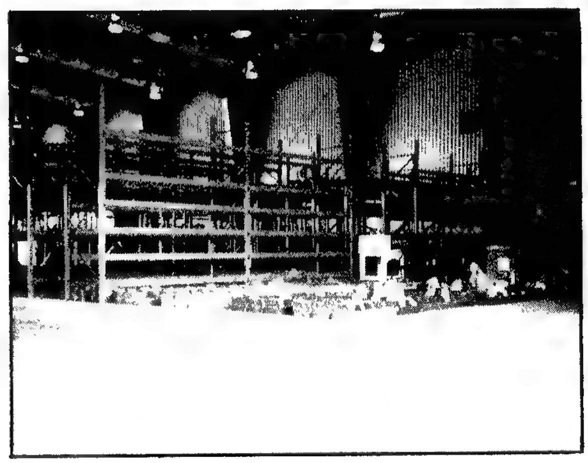


Pallet.

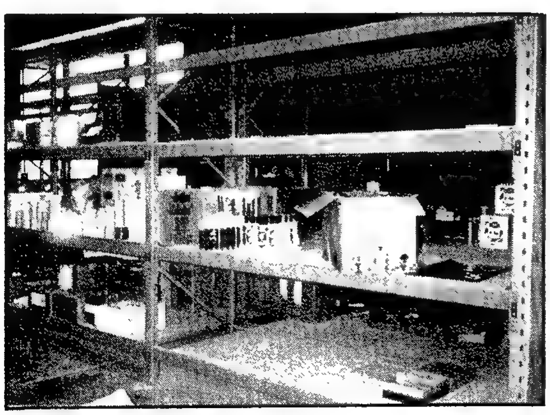
(Photos courtesy of Lt Col (Col Sel) JeffreyRoutch, 363 TFW, Shaw AFB)

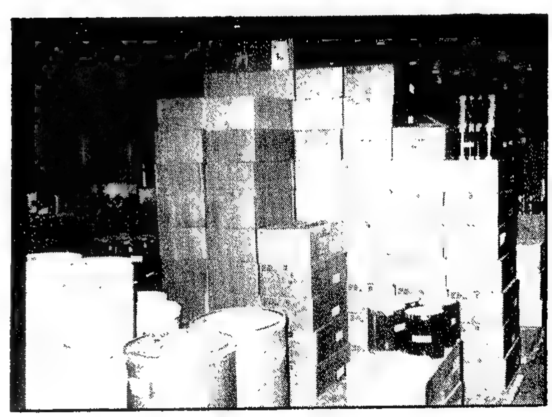


Storage bins.



Supplies... supplies.





Documentary on Desert Shield/Storm Supply Support

Lieutenant Colonel (Col Sel) John H. Gunselman Jr., USAF

This documentary attempts to capture the essence of supply support provided to all units deployed to the area of responsibility (AOR) during the Persian Gulf War effort.

- Initial support period, 2 August - 16 November 1990. This section covers the computer support and maintenance concepts for the initial deployment period. At the start of the operation, all units deployed with their war readiness spares kit (WRSK) and combat supply system (CSS) computers which were developed to maintain accountability and inventory accuracy of the kits. For the most part, initial stock replenishment and mission capability (MICAP) support was provided from home station. Units did make lateral support checks within the AOR for MICAP support prior to going to home station. In addition, numerous commodities such as oil, hydraulic fluid, construction materials, furniture, and administrative equipment were purchased on the local economy.

-- Initial support for tactical fighter squadrons was obtained from home station as depicted in Figure 1. Deployed units were responsible for checking lateral support availability to resolve MICAP conditions as the CENTAF supply staff, located at Riyadh, was not manned to search for parts. These units made maximum use of voice satellite communications because there was no connectivity between deployed CSSs and home station computers. All MICAPs were ordered by voice while floppy disks were either mailed or hand-carried to home station for WRSK replenishment actions. This was not a very timely process. However, one unit did improvise and used a Z-248 with a modem to transmit CSS transactions via commercial communications to home station—this worked better.

-- The Strategic Air Command's (SAC) initial approach was to set up a main operating base (MOB) concept with all deployed locations acting as forward operating locations (FOLs). SAC created two MOBs, one located at Moron AB, Spain, which was a satellite off of Torrejon AB, Spain, and one at Andersen AFB, Guam. Computer support was established at each MOB and all WRSKs were loaded on these computers. Unlike the fighter

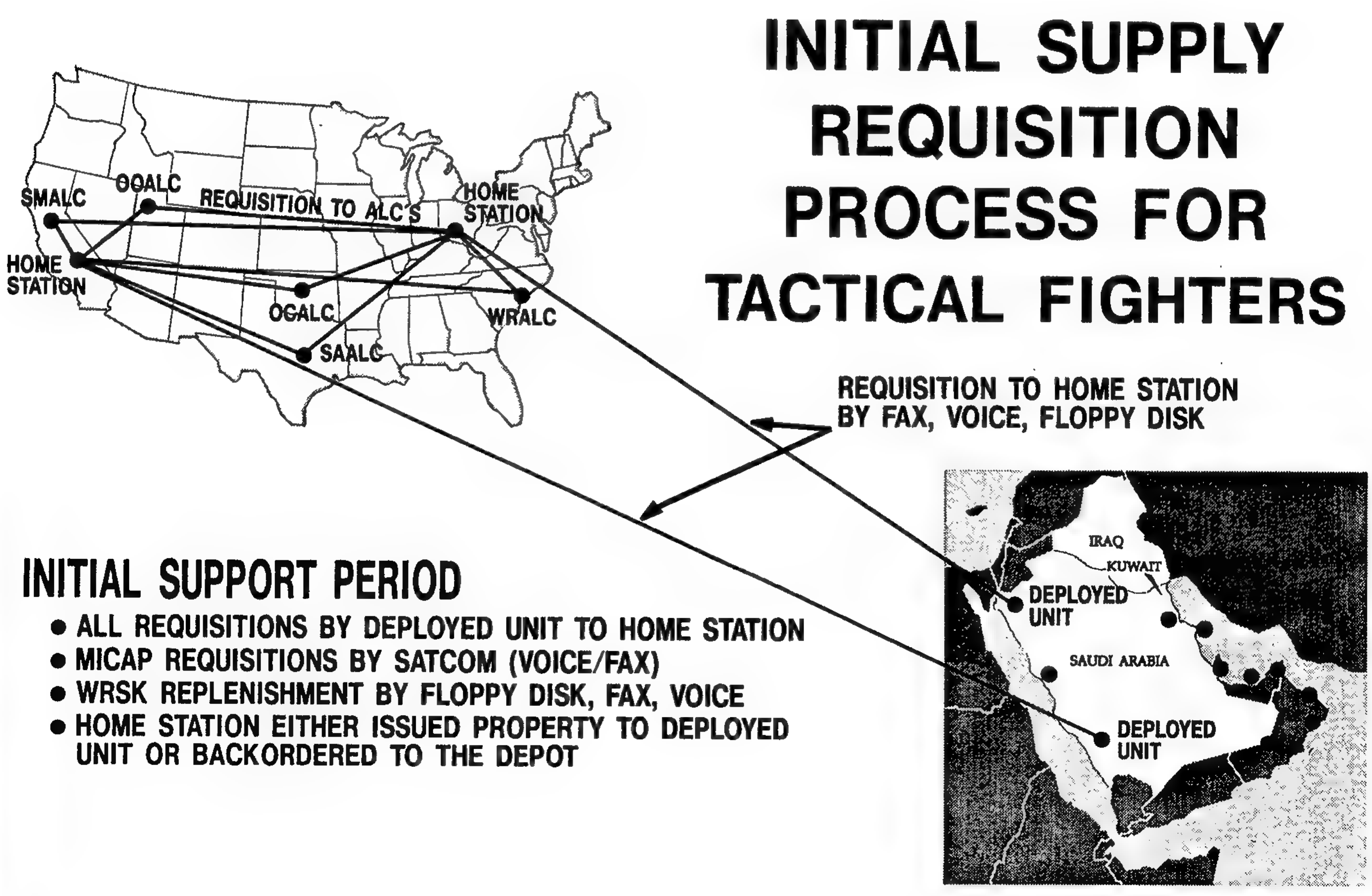


Figure 1.

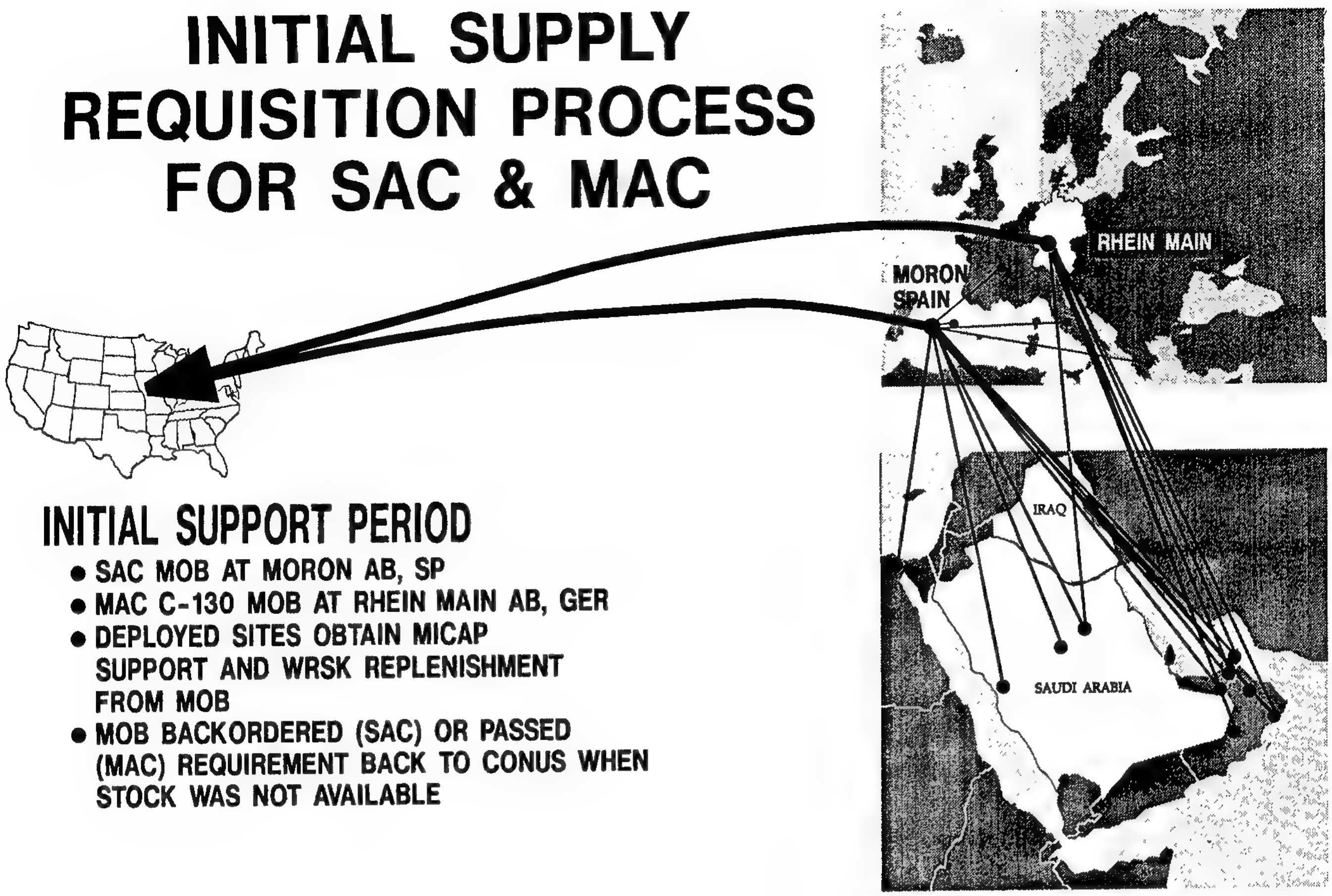


Figure 2.

units, all MICAPs were called into the MOBs versus going back to home station for support. Also, as the FOLs withdrew assets from the WRSKs, they notified the MOBs by phone since they did not have any computer connectivity with them. However, this phone contact was marginal until additional AUTOVON links were installed at deployed locations just prior to the beginning of combat operations. The MOBs then took the necessary actions to replenish the WRSKs (Figure 2). The FOLs within the AOR eventually became independent by connecting to a computer located at Langley AFB, Virginia. Additionally, the MOBs acted as theater depots performing all intermediate level maintenance which is similar to the way SAC performs regional maintenance in peacetime. Consequently, the continuous flow and repair of reparables was necessary to sustain SAC forces; however, movement of retrograde was slow. Prior to starting combat operations, SAC began to move their own retrograde and resupply using organic airlift called "Mighty Express." The Moron AB intermediate repair site had to be built from scratch, whereas the one at Andersen AFB was 70% in place at the start of the operation.

-- The Military Airlift Command's (MAC) strategic airlift units were supported by their WRSKs and forward supply system. All MICAPs were called into Twenty-First Air Force, McGuire AFB, New Jersey, for resolution via the MAC command and control system. Kit replenishment was done through the primary supply points: McGuire AFB for the C-141 and Dover AFB, Delaware, for the C-5. Because MAC was in a continuous surge, the repair of retrograde was very important to maintaining high utilization rates. Retrograde and repair and return times from the primary supply points were measured, and resupply took approximately 19 days for the C-5 and 21 days for the C-141. This was consistent with the 20-day repair cycle used to build their WRSKs to support a remove, repair, and replace (RRR) maintenance concept with repair being done at the primary supply points.

-- MAC tactical airlift units obtained their support similar to the way SAC supported their units. A main operating base was established at Rhein Main AB, Germany. A satellite account was set up on the Rhein Main computer which maintained all the WRSK computer records and performed the automated replenishment actions and inventory control functions. Units called in their spares usage and replenishment transactions were processed by Rhein Main (Figure 2). MAC units attempted to satisfy their MICAPs laterally within the AOR. If not successful they were passed to Rhein Main where personnel attempted to source the assets. If Rhein Main was not successful, they were passed to Twenty-First Air Force for sourcing. Additionally, all reparable items were sent to Rhein Main for repair or evacuation action back to a depot.

-- The majority of USAFE unit's wartime planning prior to Desert Shield was to fight in place. Consequently, they only had six existing WRSKs which were not enough to support the number of forces they provided. Therefore, using the Dyna-METRIC Microcomputer Analysis System (DMAS), they computed high priority mission support kits (HPMSKs) to support their deployment and they sourced the assets from within

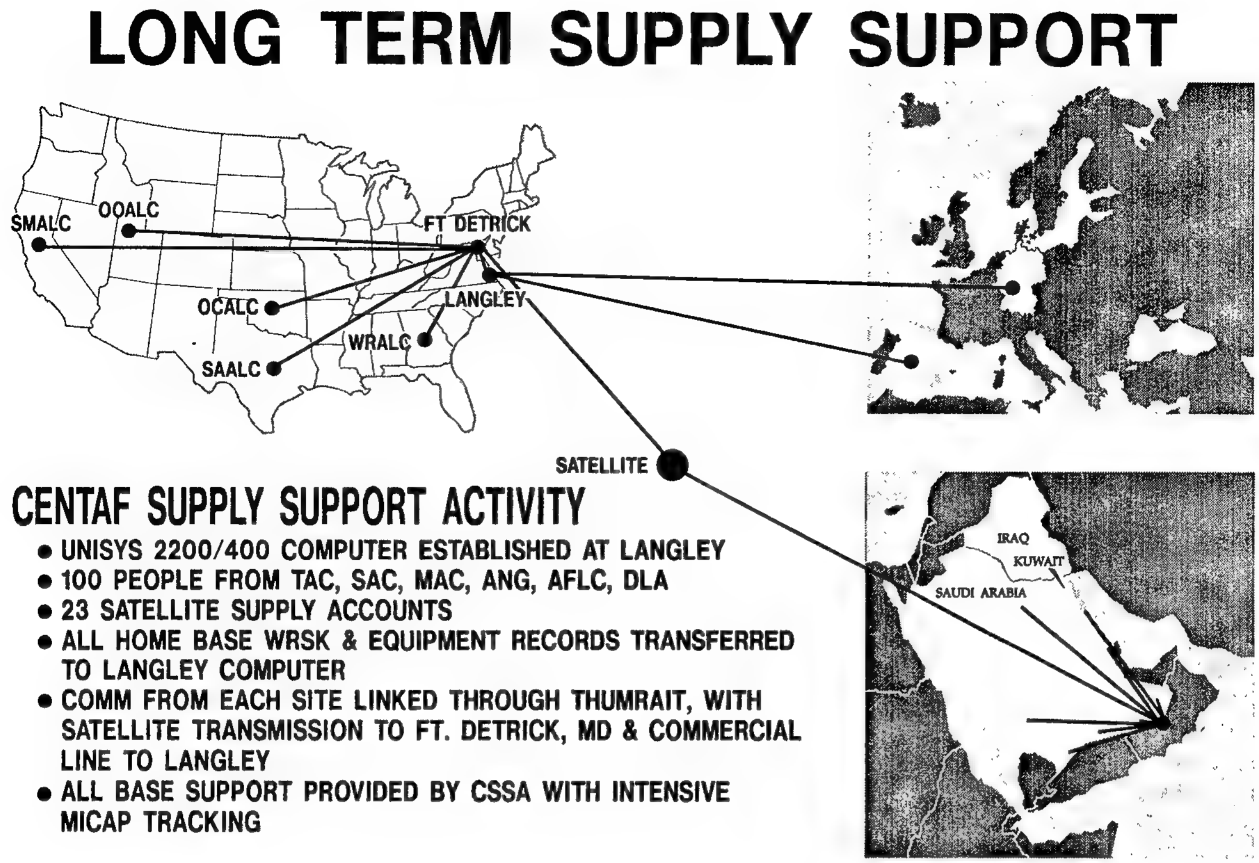


Figure 3.

USAFE. A total of 13 HPMSKs were developed and deployed costing over $569 million. Initially, their resupply support came from each deployed unit's home station.

— The highly mobile Special Operations Forces received virtually all their support from home station. WRSK replenishment was provided by the unit's home station based upon daily situation reports (SITREPs) identifying WRSK expenditures. Regionalized repair and supply support for MC-130, HC-130, and common C-130 spares was first established at Rhein Main AB but was later relocated to the theater operating base due to transportation problems. MICAP requirements were phoned to the Air Force Special Operations Command Logistics Readiness Center (LRC) at Hurlburt Field, Florida. The LRC sourced the requirements and tracked them from source of supply to receipt in the desert.

-Long Term Support, 17 November 1990 to end of operation.

This section will address the computer support provided to the provisional wings for sustaining supply support. It will also address the functions performed by the CENTAF Supply Support Activity (CSSA), follow-on spares support, support to PROVEN FORCE, and HARVEST FALCON.

-- Existing plans called for units to deploy with their CSS to maintain accountability and inventory control of WRSKs with kit replenishment action provided by a computer support base mainframe computer. WRSK replenishment was dependent upon getting the CSS transaction files back to the computer support base. Various mediums were available, but the one most preferred, electronic, was not immediately available because of connectivity problems. Consequently, CSS transactions were updated at the computer support base by either mailing or hand-carrying floppy disks. Therefore, as the US presence in the AOR was extended, a longer term approach to provide sustaining supply support had to be developed.

-- According to plan, tactical shelter systems (TSSs) with a full-up supply computer were to have been deployed; however, because they are fragile, there was considerable risk of damage during shipment. Also, there was no previous experience with deploying these systems, their reliability was questionable, and their operating systems were not upgraded to the current configuration. Additionally, deploying the TSSs would have increased the manpower requirements in the AOR as computer operators, stock control technicians, and financial material accounting personnel would have been required. Finally, there were not enough available TSSs to support 21 active accounts so they were not deployed.

-- CENTAF, therefore, opted to regionalize computer support through the Headquarters Tactical Air Command (HQ TAC) MAJCOM Development Center located at Langley AFB which possessed a UNYSIS 2200/400 series computer. For communications connectivity, CENTAF obtained a dedicated channel on a dedicated military satellite. Data processing center terminals, along with remote job entry terminals, were deployed to the AOR. This allowed the deployed locations to have real time access to the Langley computer. Installation teams were sent to activate 21 individual supply accounts. Using tactical communications, data was transmitted to Thumrait, Oman, where it was sent via satellite to Ft Detrick, Maryland, and on to Langley over a dedicated commercial line as shown in Figure 3.

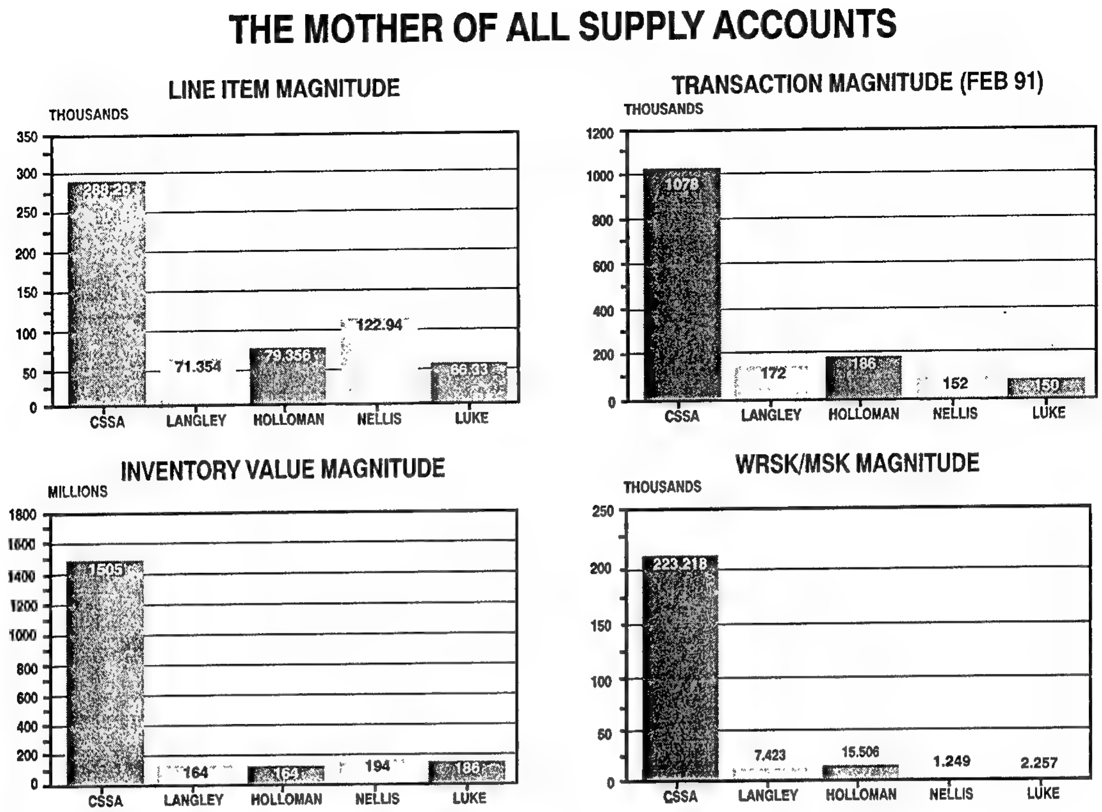


Figure 4.

This support unit at Langley AFB was called the CENTAF Supply Support Activity (CSSA).

-- The CSSA consisted of over 130 people and performed all the stock control and file maintenance functions for all units deployed to the AOR. Figure 4 depicts the magnitude of the operation. All WRSK and Follow-on Spares Kit (FOSK) authorized quantities were uploaded on this computer. Deployed units no longer went to home station for support. They received new stock record account numbers and became independent. All financial accounting was done by the CSSA, which made it easy to track the cost of support. Deployed units continued to make lateral support checks within the AOR; however, if not successful, they called the Mission Support Section at the CSSA. The CSSA Mission Support Section personnel then aggressively tried to resolve all MICAP requirements for most weapon systems in the AOR using the MICAP Asset Sourcing System (MASS) to locate available assets worldwide. Forty-five percent of all MICAPs were resolved through lateral support action. SAC units, except those located throughout Europe, as well as MAC units, except for strategic airlift forces, were also loaded on the CSSA. The CSSA computer routed all requisitions for SAC B-52 and KC-135 aircraft to Moron AB on a fill or backorder basis. SAC MICAP requirements for units located in the AOR were called into the CSSA which in turn called them into the regional repair center at Moron AB. If not available, B-52 MICAPs were resolved by Eighth Air Force, Barksdale AFB, Louisiana, while KC-135 MICAPs were resolved by the CSSA. Requisitions for MAC C-130 requirements were routed through Rhein Main AB on a fill or pass basis to the depot. MAC C-130 MICAP requirements were reported directly to Rhein Main by the MAC airlift control element teams. Rhein Main personnel resolved these in lieu of passing them to the CSSA.

-- Because of the centralized support provided by the CSSA, 300 to 400 supply personnel did not need to deploy to the AOR as would have been required using the TSS support concept. The CSSA proved to be a viable concept and is being documented for future support.

-- Not only did the CSSA manage requirements, it actually performed the local purchase function for the AOR for many non-aircraft spares. This allowed CENTAF to take advantage of quick payment discounts. Additionally, all local purchase deliveries went to Langley AFB where they were inspected by CSSA personnel and then put on MAC airlift to the AOR. This eliminated the difficulty of commercial vendors getting assets into MAC airlift channels.

-- Since combat did not start until approximately six months after the initial deployments, CENTAF wanted to keep the WRSKs as full as possible since they were built to support the initial wartime surge. Therefore, the emerging FOSK computational methodology was used to compute the additional spares necessary for the AOR. The computation provided the amount of spares required to support the prewar flying. The FOSK was built to support a remove, replace, and repair (RRR) capability. This significantly increased the capability of many WRSKs that were built to support a remove and replace (RR) maintenance concept.

-- As war became imminent, another front was opened in Turkey and USAFE provided the support to these forces under code name "PROVEN FORCE." From December 1990 to January 1991, five satellite accounts were established on the

Ramstein computer to support the PROVEN FORCE units. All MICAP requirements and WRSK/HPMSK replenishments were ordered through these accounts and were sourced from within USAFE by the HQ USAFE Logistics Supply Cell.

-- Because of the magnitude of the number of items and detail records involved with the HARVEST FALCON kits that deployed into the AOR, these records were not transferred to the CSSA. They remained under Ninth Air Force's control at Shaw AFB, South Carolina. Replenishment actions for these housekeeping assets were accomplished by message and telephone back to the remaining CENTAF staff at Shaw who updated the computer records.

- Spares Allocation and Distribution

-- Spares were allocated to the warfighting units based on the Uniform Military Movement and Issue Priority System (UMMIPS) and JCS project code "9BU." The allocation sequence caused assets to be released to warfighting units ahead of non-warfighting units requisitioning with the same priority. For example, a priority 02 WRSK replenishment requisition using project code 9BU would release before a MICAP non-9BU priority 02 requisition. This was one of the many factors that enabled the mission capable rates for the AOR to consistently average above 90%.

-- The distribution of spares within the AOR was accomplished by dedicated C-130 flights called the "Camel Run." The Camel Run moved spares from Riyadh and Dhahran to the provisional wings. To support the C-130s, MAC built HPMSKs and placed them at these two locations. To support the materials handling equipment required throughout the AOR, MAC located HPMSKs at Rhein Main AB and Dhahran which acted as central distribution points for these spares.

-- The regional repair center at Rhein Main was repairing assets on a first-come first-serve basis in support of the five C-130 squadrons deployed to the AOR. To help maintenance prioritize repair and distribute the assets to the location with the most need, MAC installed the prototype Theater Repair and Distribution System (TRADES) at Rhein Main. TRADES was developed under direction of HQ USAF/LGSS and provided a capability to prioritize maintenance and distribute assets to maximize aircraft availability at deployed locations. The TRADES prototype worked well in support of the C-130s.

-- As replenishment supplies got backlogged in the flow at Dover AFB, it became apparent that an overnight delivery service was needed for high priority cargo. Consequently, Desert Express was established. This was a daily C-141 flight from Charleston AFB, South Carolina, that flew direct to Riyadh and Dhahran carrying only high priority cargo identified by project code 9AU. For Air Force cargo, the MICAP designator identified the asset as Desert Express eligible. All Desert Express shipments had to be approved by the airlift clearing authority prior to being moved to Charleston. This service was eventually expanded to two flights per day as hostilities heightened. A flight from Europe was also added in December 1991.

- Retrograde. The return of reparable spares became important since follow-on support calls for the repair and return of recoverable assets. Therefore, an orderly flow of retrograde must occur. Retrograde moved well from the AOR to consolidation ports. However, bottlenecks occurred at Rhein Main AB, Dover AFB, and Charleston AFB as pallets had to be broken down to move property to end destinations. To alert transportation of priority Air Force cargo, Air Force project code 672, nicknamed PACER RETURN, was developed to alert transportation of priority retrograde. Any pallets with cargo containing this project code were broken down ahead of other pallets. In the future, priority retrograde will be assigned by the computer based upon the availability of reparable carcasses at the technical repair centers. Those items that are in an asset short position will be afforded priority handling and will be identified as such on the shipping document. Also, priority handling can be manually assigned if wartime assessments determine the item is mission critical.

- Assessments. To support initial deployments, weapon system management information system (WSMIS) sustainability assessment module (SAM) assessments, as well as prioritized lists provided by the MAJCOMs, were used by the Air Force Logistics Command (AFLC) to help identify surge requirements. However, after deploying, WSMIS was essentially blind because parts availability at the deployed locations was not visible until the CSSA became fully operational. However, DMAS was used by HQ TAC using data updated from the home station processing of CSS transactions. Once the CSSA came on line, WSMIS was again used to identify sustainability of deployed spares and to identify problem parts. The first few output products required adjustments to the assessment parameters so they reflected the actual sortie rates and durations and logistics support concept (maintenance concept and FOSK availability) being experienced in the AOR. Once adjusted, an accurate assessment was made but was never used as the war ended so quickly. The problem parts output was to be used as a guide to prioritize depot repair.

- Lessons learned. Numerous lessons learned evolved from this operation. The most pressing are:

-- Problem: resolve the problems of transitioning supply operations from peacetime to wartime support.

--- Solution: institutionalize the CSSA concept and replace the CSS with a system that can provide support during the initial employment phase of no communications connectivity without mainframe support and that is capable of transitioning to regional mainframe support once connectivity is obtained.

-- Problem: lack of adequate voice and data communications affected the timely transmission of supply requirements to sources of supply.

--- Solution: voice and data communication nodes that will meet user requirements must be deployed very early.

-- Problem: there is a need for overnight transportation service for critical cargo.

--- Solution: institutionalize express transportation for high priority cargo as demonstrated by the Desert Express. Ensure this requirement is included in all planning documentation.

-- Problem: visibility over retrograde movement must be obtained and high priority cargo must be identified for expeditious movement.

--- Solution: field systems such as the cargo movement operations system (CMOS) and the Air Force logistics information file (AFLIF) which can identify where an asset is in the transportation system. Automate the identification of priority retrograde.

-- Problem: the Air Force flooded the system with priority requisitions to include stock replenishment.

--- Solution: the FOSK programs being developed will requisition stock replenishment as priority 05 versus priority 02. These should be available in February 1992.

-- Problem: the assessment system needs greater flexibility as it took too long to produce accurate theater assessments.

--- Solution: funding to develop an operations plan matrix within WSMIS SAM will allow a swifter transition to aligning the database to perform theater level assessments on deployed forces.

-- Problem: USAFE units were tasked to deploy that did not have WRSK as they were fight-in-place units.

--- Solution: the mission of USAFE units needs to be reviewed, and if merited, authorize WRSK in lieu of base-level self-sufficiency spares (BLSS). This is currently being staffed.

-- Problem: spares were not available to support the prewar operations tempo.

--- Solution: the current FOSK concept will allow the kits to be deployed early to provide this support.

-- Problem: deploying squadrons not only changed location, but also changed stock record account numbers as they became autonomous. This caused numerous problems because requisitions could not be transferred from one account to another.

--- Solution: to facilitate the transition of deploying squadrons from peace to war, the supply community proposed to assign a unique stock record account number (SRAN) to deployable squadrons. The Air Force Logistics Management Center (AFLMC) is currently evaluating this proposal under project number LS912098 and plans to publish its findings by July 1992.

-- Problem: spares allocation was perceived by other MAJCOMs not fighting the war as not being equitable because the JCS project code released assets to the AOR first if they were equal priority. Consequently, stock replenishment was allocated to the AOR before a non-warfighting MICAP was satisfied.

--- Solution: the advent of DRIVE distribution will resolve this allocation problem as unit priorities must be identified. DRIVE will maximize aircraft availability based on the unit priorities and aircraft availability targets.

-- Good news: regional maintenance activities work and can be supported by a dynamic supply system.

--- Action required: transportation pipeline times to and from these regional repair centers must be agreed upon to compute requirements for follow-on support. Additionally, continue TRADES development from a prototype system to a standard Air Force system.

-- More good news: MASS worked extremely well.

Lt Colonel John H. Gunselman Jr. wrote this article while Chief, Supply Policy and War Planning Readiness, Directorate of Supply (HQ USAF/LGSS), Washington DC. He is presently Chief, Systems Division, HQ TAC, Langley AFB, Virginia.

READER EXCHANGE

Dear Editor:

My compliments and thanks to Professor W. Carroll Widenhouse of AFIT for his perceptive, illuminating, and interesting article, " MTBF - What Does This Term Really Mean?" (Summer 1991 *AFJL*).

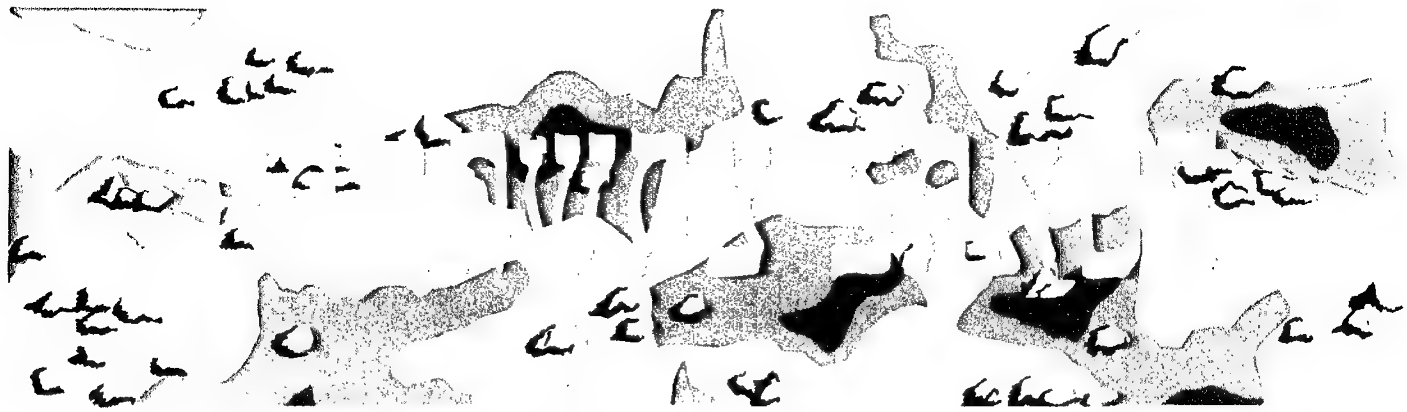
Professor Widenhouse was right on the mark. In particular, I enjoyed the exposition on "failure" being dependent on one's perspective.

For further information on MTBF and its reciprocal, failure rate (λ), I recommend Professor Ben Blanchard's excellent text, *Logistics Engineering and Management*, 3rd Edition. On page 28, Table 2-1, Professor Blanchard lists the considerations, often overlooked by planners, for the combined failure rate of a component. These include dependent (secondary) failures, operator-induced failures, and maintenance-induced failures. This concept is an appropriate supplement to the ideas expressed by Professor Widenhouse.

Oscar J. Dorr, C.P.L.
4712 Gorham Avenue
Orlando, Florida 32817

Most Significant Article Award

The Editorial Advisory Board has selected "Stock Funding of Depot Level Reparables" by Major Chip Lewandowski, USAF, as the most significant article in the Summer 1991 issue of the *Air Force Journal of Logistics*.



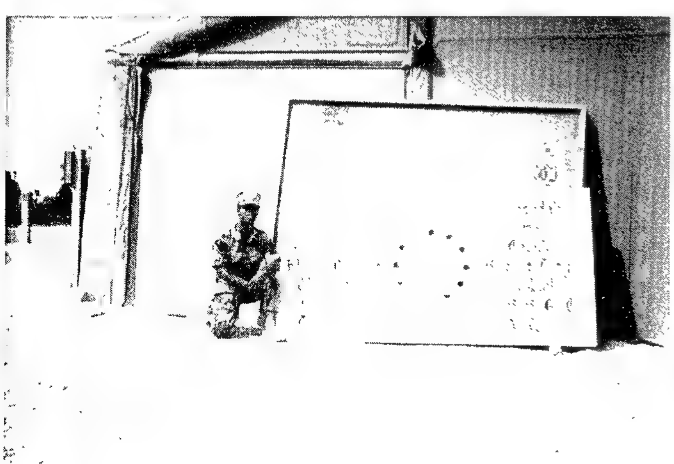
The Journal invites its readers who participated in Operation Desert Shield/Storm to share their personal experiences with others for the next few issues. The following is an account of Major Milton T. Siler's involvement with the first linehaul transportation organization to operate in a combat environment. Major Siler is assigned to the Directorate of Transportation, Air Force Logistics Management Center, Gunter AFB, Alabama.

Blueball Express

The shooting war was over! Sitting at my desk at the Air Force Logistics Management Center, I reflected on the fact that none of the Center's many volunteers were called upon to serve in the Gulf. As it turned out, my thoughts were premature. I had no idea I would be sitting in the desert just two weeks after the cease-fire. The Air Force was looking for majors with water port operations experience to go to Southwest Asia to help with the redeployment. Two days after official notification, I was on the plane heading for the theater of operations. Arriving there on the 17th of March, my first memorable experience happened before I even left the airport. Because I had a US armed forces identification card and contingency orders instead of the usual passport and visa, I was confined to the airport lobby until the American Embassy could convince officials they should allow me into their country. Midafternoon the next day, approximately 16 hours after my arrival, I was released from the airport and made my way to the American base. There, I was given a cot in a tent with four other occupants. This would be my home for seven days. During that time, personnel assigned to the new water port liaison office filtered in, and eventually we were a unit of seven personnel. Our support base, which had been there since August, was packing up and going home. Because we had just arrived, we had to find a new home, so we began operating out of the American Embassy. For three weeks, life was not all bad. But business was slow. USCENTAF Transportation decided its water port personnel could be utilized more effectively elsewhere; the extended redeployment schedule was not providing enough workload to justify the manpower invested. I totally agreed with their assessment and was eager to move on to something more challenging. Little did I know how challenging my new assignment would be! I was the new Officer in Charge of "Blueball Express," the first linehaul transportation organization to operate in a combat environment. This was a once-in-a-lifetime opportunity that most any transporter would have welcomed.

Blueball Express, often referred to simply as BBE, was truly a unique transportation organization. When personnel were first identified for assignment to BBE, the only requirement was that they be tractor trailer qualified. Besides vehicle operators, we had munitions and civil engineer heavy equipment operators. We also had aerospace ground equipment mechanics, vehicle mechanics, supply, communications-electronics, and power production personnel. As a result, BBE had a wealth of knowledge and expertise covering a wide variety of Air Force specialties. We were largely self-sufficient and able to take care of ourselves. During the war, Blueball Express primarily transported munitions and aviation fuel to sustain the air campaign and subsequent ground offensive. They operated out of four independent operating locations. Even though they communicated at times, there was actually little interaction between the sites because they each supported a different air base. Then the shooting stopped and the Blueball Express mission changed.

American troops started for home and bases were marked for closure. The assets from those bases had to be moved to the reconstitution sites where they would be inventoried, repaired, packed, and stored. The Blueballers were tasked to transport



much of the cargo, which could be done more effectively and efficiently if the resources were combined. Consequently, the entire operation was consolidated and moved to a central location. Everyone spent the first few days together getting used to the new arrangement. I formally met all the Blueballers in early April at a cookout that gave everybody a chance to get acquainted, welcome them to their new home, and say "job well done." Afterwards, it was time for me to get busy.

My job was the type any person who has ever felt encumbered by rules and regulations would have loved. I had over 200 people, 118 tractor trailers, limited but adequate resources, and a mission. How the job was done was my responsibility. Being the first organization of its kind, we had no regulations or operating instructions. Using personal and professional experiences, trial and error, suggestions, foresight, or whatever else was available, my senior NCOs and I constructed an organization tailored to enhance the transportation of cargo throughout Saudi Arabia using tractors and 40-foot trailers. I enjoyed a great deal of latitude in determining how to get the job done. Only our collective imagination restricted the evolution of Blueball Express into a viable transportation organization.

Things were going well and the guys were kept busy on the road. Then activities "up north" began to gain more and more attention and eventually began to slow progress toward closing the bases. The plight of the Kurdish refugees and our subsequent shift from a rapid redeployment to a "wait and see" posture depleted all the cargo that was available for movement. The lack of work presented special challenges for me when trying to explain to the younger airmen why we had no cargo to move, yet we were still needed in Saudi Arabia and could not be released to go home. Being away from home, the best medicine for the Blueballers was to keep busy moving cargo. Time seemed to pass quicker and many of the convoy crew members truly preferred being out on the road. Idle time usually served to remind everyone that they would rather be somewhere else, and was often the cause of sudden bouts of depression. I didn't have the problem of too much idle time though. In fact, I was in-country several months before I took my first day off. There was just too much to do. Every day presented new situations that needed to be resolved. It wasn't that everything was a problem; sometimes it was as simple as establishing, standardizing, interpreting, or clarifying new policies or procedures.

I wasn't over there long before days of the week had no relevance at all. The first thing that threw me off was the Moslem weekend. Their weekend was Thursday and Friday, with Friday being their holiest day of the week. Many American activities which depended on or closely interfaced with Moslems observed their holy day and closed on Fridays, while other American activities closed on Sundays. Trying to remember when someplace was closed and when it was open sometimes became confusing. For instance, Sunday brunch was served on Fridays. The post office was closed on Fridays, but the base exchange was closed on Sundays. Consequently, I would forget what day it was or get the days mixed up. Besides, working every day made the days all the same. Working every day was not without reward though. I liked what I was doing. I could see progress every time a convoy returned, and I knew we were making a valuable contribution. Unfortunately, everyone was not as enthusiastic about their desert assignment.

Being a Blueballer was not an easy job. Responding to the call whenever we had a requirement to move cargo, we were on the road all hours of the day and night. Many times we were on the road for as many as four days straight in unrelenting heat and extremely hazardous driving conditions. And Blueball convoys did not always receive the warmest of receptions at the bases they serviced. Arriving in the middle of the night was not the way to make lasting friends. Often no one was around at the origins or destinations to assist in loading or unloading cargo off the trucks. Sometimes the points of contact had already caught a flight back home and we never got the word. After being on the road for 10 or 12 hours, the last thing the guys wanted was an unwarranted delay in unloading cargo. But the convoy crews persevered through it all. Blueballers were a great team doing whatever it took to get the job done.

As I think about the memories that continue to stick with me since my return from the desert, one of the most vivid is the support given by the Americans back home. We observed that when our forces went to Southwest Asia, the support of America went too. We received hundreds of cards, letters, and gift boxes which attested to the time and money generously donated to armed forces serving in the Gulf. And the support was genuine. Even when I returned to the States en route to my home station many months after most of the main forces had returned home to victory parades and celebrations, many people still approached me and thanked me for wearing the uniform and serving our country.

I don't regret anything associated with my time in the desert. I learned a lot, shared a lot, saw a lot, and met a lot of good people getting the job done. BBE was a proud organization—proud of its role in the history of Air Force transportation and proud of its accomplishments. I know that I'm a better person for having had the experience.

Captured Iraqi equipment.

Be Wary of Revisionism

Colonel Terence H. Berle, USAF (Ret)

"We will study the lessons of this war [DESERT STORM] to prepare for the next conflict. So will our potential adversaries. We need to learn from this war, not repeat it."

Donald B. Rice
Secretary of the Air Force
February 1991

"Those who cannot remember the past are condemned to repeat it."

George Santayana

"Logisticians are a sad, embittered race of men, very much in demand in war, who sink resentfully into obscurity in peace."

Anonymous

"Revisionist: A person who revises or favors revision of, some accepted theory, doctrine, etc."

Webster's New World Dictionary

Many logisticians are studying and recording the results of Desert Shield/Storm. They must heed the advice of Secretary Rice to study those lessons recognizing, however, the next war will be different. In addition, recorders must take care to place their lessons in perspective of national objectives, geography, capabilities of the enemy, and capabilities of host nations. Future researchers will reference these efforts to make conclusions on future logistics systems. The history must show all influencing factors which led to success or failure of individual policies and procedures. Only by providing this information and hoping future researchers will examine it in detail can we avoid the admonition of Santayana.

Today's logisticians must exercise care in documenting the lessons from the recent conflict. Future logisticians must use equal care in reviewing the documentation to properly learn from history. The "sad, embittered race" of logisticians often indulges in self-flagellation to avoid obscurity. They attribute failures to logistic systems rather than examining the contribution of objectives, strategy, and tactics. This self-flagellation falls often to the revisionists.

The Fall 1990 issue of the *Air Force Journal of Logistics (AFJL)* contained an article which was a prime example of how history can be misinterpreted. The article should be reviewed and analyzed by logisticians who are undertaking the difficult task of determining the lessons learned from Desert Shield and Desert Storm. The article, "Logistics Support Limitations in the Vietnam War: Lessons for Today's Logisticians," by Major Benjamin L. Dilla, USAF, ranks high among examples of current rewriting of the "history" of the Vietnam conflict.

The article appears to be a scholarly review of the lessons from Vietnam, providing over 40 references from 10 previous articles, books, and reports. The direct references set forth many, but not all, problems found in the history of logistics in the Vietnam conflict. Facts and perceptions from the publications are included, but the author never seems to look at totality or the conclusions in the cited works. Instead, using selected snippets, new conclusions are presented in a manner similar to the erroneous mathematical procedure of "averaging averages." This article is an example of increasing revisionism of the military successes in Vietnam by confusing them with political failures and by ignoring objectives.

The purpose of this article is to point out the necessity for documenters of Desert Shield/Storm to identify and strongly highlight the environment that influenced logistics actions, the effectiveness and or efficiency of the actions, and how the customer (the operator) was affected by logistics. The Dilla article is an example, unfortunately, of how some "historians" only look at small portions of documented problems while ignoring the big picture. It points out the need to identify all aspects and influencing facts with each conclusion so erroneous opinions may be refuted.

Revisionists are often prejudiced, afflicted by tunnel vision, or searching for a new approach justifying publication. When using tunnel vision, they examine, with great detail, small parts of the whole and make erroneous deductions which lead to major erroneous conclusions.

Basic tenets of military activity are that National Security Objectives must guide all planning; and the military portion of those objectives must be supported by an equal consideration of military strategy, tactics, and logistics. The Dilla article "tunnels" only (purposely, according to the author) into discussion of the logistics leg of the triad. His major conclusion does not address the national security objectives or the impact of the objectives on logistics support and organization, and does not look beyond the "problems" identified in cited historical documents and analyses. This selective review of one of many intertwined issues causes the revisionist failure.

The major conclusion of the article is stated in the section entitled "Lessons Learned."

> This paper has examined logistics support in the Vietnam War and found that <u>logistics constrained the war effort and contributed significantly to US failure.</u> (2:37) [emphasis added]

This conclusion, and many of the secondary conclusions that led to it, are refuted in a primary quotation from the Executive Summary (Vol I) of the primary source document (*A Review of Logistics Support in the Vietnam Era*) used in the *AFJL* article. This document was prepared by the Joint Logistics Review Board (JLRB), a special analysis group chartered by the Secretary of Defense in 1969.

> *CUSTOMER SATISFACTION.* These [logistics] tasks were not easily accomplished, nor was progress always smooth, efficient, and economical. On the contrary, the logistic effort often seemed to lag behind the demands for facilities, personnel, equipment, and money. It was not until the end of 1968 that the logistic structure in terms of organization, personnel, and facilities was fully adequate for the tasks at hand. <u>A notable aspect of this situation was the almost unbelievably high satisfaction of the demands of the combat units. The military commander in</u>

Vietnam, the General Accounting Office, and Congress all have attested that, with relatively minor and temporary exceptions, U.S. forces committed to conflict have never been better supplied than those in SE Asia. In this context, it may be said that the logistician achieved his goal—satisfying the requirements of the soldier, sailor, marine, and airman facing the enemy at the end of the logistic pipeline. (3:4) [emphasis added]

The first part of the JLRB quote confirms some of the facts but refutes Dilla's conclusion. The conclusion reached by a researcher 20 years after the fact points out poignantly why documenters of Desert Shield/Storm must take care, examine all influencing factors, and continuously admonish readers to follow Secretary Rice's recommendation. However, even with adequate warning, misinterpretation may occur. As the JLRB predicted:

This report, like any analysis leading to recommendations or improvements, may tend to obscure a creditable logistical performance by accentuating difficulties and inefficiency. (3:4)

Another problem, evidenced in the Dilla article—and anticipated in the JLRB documentation—is the differentiation between logistics efficiency and logistics effectiveness in combat operations. Efficiency in this sense means there was a better way to accomplish the tasks at lower cost and less work, while effectiveness means ability to support the execution of strategy and tactics. The JLRB is very concise in this differentiation:

The JLRB has concluded, as others have concluded, that logistic support of U. S. combat forces in SE Asia during the Vietnam era was effective, but that the efficiency, and hence the economy, of that support could have been improved. (3:22)

General William T. Sherman once said that "War is Hell." He could have added that war is expensive and usually inefficient. No doubt, 20 years from now some revisionist, presently in grade school, will review the reports from Desert Shield/Storm and conclude logistics was inefficient and costly. Hopefully, the inefficiency will not be confused with ineffectiveness to reach a conclusion that the logistics created a military failure. Even an admonition as strong as that presented by the JLRB will not overcome tunnel vision, but the admonition must be made by documenters of support in this latest conflict.

The JLRB found many logistics problems. However, close reading of the report shows they were properly placed in perspective of efficiency and effectiveness. The JLRB also addressed the problems between military and political objectives—especially in logistics planning and organization which were greatly affected by our national security objectives. The revisionist view provided in the Dilla article does not adequately address this environment which is so important to the analysis of success or failure of the military logistics system.

The basic military policy supporting US national security objectives since World War II has been to deter aggression and, if it occurs, to defeat the aggression on terms favorable to the United States. The concept of win (total defeat of the national integrity of the aggressor) has not been one of the objectives. In the early 1960s, when the US involvement in Vietnam began, the primary political, economic, and military strategy to achieve our objectives was "containment"—the strategy of halting movement of communist or totalitarian government into areas not already affected. The objectives, policy, and strategy in Vietnam in the decade of the sixties were to halt a communist inspired insurgency within the geographic boundaries of South Vietnam.

Examine two conclusions reached in the Dilla article:

At worst, problems of logistics support made the war unsustainable and unwinnable even if the nation had been committed to win. (2:35)

The system [logistics] had problems supporting an effort that ultimately led to withdrawal and defeat; it could not have supported a more intensified effort without significant changes. (2:37) [emphasis added]

The first quotation introduces erroneous conclusions about sustainment and winning. The JLRB study definitely supports the ability of the services to continue sustaining the forces in Vietnam (even if it was done inefficiently). While the report does document scattered (geography and time) instances of short supply of items (such as ammunition), the JLRB was quick to note that they were not unsurmountable. The national objective at the time was to halt expansion of communism vice "winning" against the perpetrators—North Vietnam and its sponsors.

The second quote is patently wrong for two reasons: the logistics system did not lead to a "withdrawal and defeat"; and the intensified effort, not part of the planning, has never been identified as an issue that could not be overcome. The article assumes the logistics effort expended to meet that objective would not, and could not, have been changed if the objectives had also been changed. There is no basis for this conclusion. Further, we have no evidence indicating logistics would have failed had the US government decided to apply a more intensified effort. Such decision would most certainly have required strong national action to obtain Congressional support, citizen support, and industrial support. More than likely, it would have required a powerful Presidential statement of national emergency and maybe even a plea for Congressional action to declare war.

As noted, the JLRB Executive Summary asserts that the customer, defined in this sense as the operational commander, had what was needed when it was needed. If the objectives, strategy, or tactics were wrong, the logistics accomplishments should not be disparaged or misstated.

Admittedly, a far more intensified effort could not have been supported without significant changes in the logistics system. But, a more intensified effort was not called for: The logistics system was not changed to meet a non-requested or non-required capability. In fact, excesses of logistics assets, as noted in the JLRB report, were very common and overtaxed the ability to control them.

Some of these excesses were in the area of logistics support the military leaders provided the troops to try to overcome their being in an unwanted war. "These unnecessary accoutrements [morale and high standard of living practices] strained an already overburdened logistics system and actually reduced combat capability." (2:37) This quote forms a subordinate conclusion of the Dilla article using the fact that these issues existed but somehow, unsupportedly, assumes that providing them reduced combat capability. If fact, both the excesses and the combat capability were maintained. Again, the JLRB rightfully asserts that effectiveness was maintained but inefficiency was widespread.

The planned omission of an intensification effort does not lead to the conclusion "the system had problems supporting an effort that ultimately led to withdrawal and defeat." The Nixon Doctrine, which called for US assistance to allies while looking to the nation directly threatened to provide the manpower for its defense, led to the "Vietnamization" of the conflict. This required training South Vietnamese forces and building up their military and logistics capability to take over the conflict. This

was done while continuing to logistically support a major international military effort. Arguably, our objectives were achieved—a success vice a defeat. The logistics support necessary to establish the South Vietnamese military was fully successful although the political hope they would have the fortitude and staying power to use the capability was not.

Finally, one more significant misinterpretation must be examined.

> One must remember that the tide of public opinion turned against the war effort after the enemy's Tet offensive in 1968. What different result might have been obtained if the US had been able to support a larger, more effective effort prior to this time? (2:36)

An interesting conjecture. Even more interesting is the elusive conjecture of how the question was derived. This author has reviewed many histories of the Vietnam conflict. I know of no reference to an inability, based on support considerations, of our national leaders or the military leadership in Vietnam to expand the effort prior to Tet. In fact, the policy was gradual escalation—meeting expanded efforts of the opposition with equal expansions. As General Raymond G. Davis, USMC (Ret), has stated in reflection on the war:

> ...limited war, graduated response, and tit-for-tat ideas all based on some theory of human rationality and effective gamesmanship got in the way of a clear statement of the purpose and role for the armed forces being deployed. (1:75) [Note: Nowhere in General Davis' listing of "Twelve Fatal Decisions" was logistics support mentioned as a problem.]

This incremental application of military power "...with continual changes in logistics requirements [furnished] little opportunity for coherent long-range planning." (3:4) But this is not to assert that the strategy and tactics associated with gradual response was in error. That decision established the logistics baseline. Logisticians do not strive to establish a support system in excess of that required by an operational commander any more than they strive to produce one that is less than required. Logistics and the established strategy and tactics—as espoused at the time—must be fully meshed. Perhaps if strategy and tactics had been different, the logistics system could have been more robust before Tet, thus obviating Dilla's comment, "It is not for the Joint Logistics Review Board, however, to examine the national security and economic considerations that led to these decisions on the conduct of the conflict...." (3:5)

Some minor credence to Major Dilla's conjecture about pre-1968 activity is found in the previously cited JLRB quote, "It was not until the end of 1968 that the logistic structure...was fully adequate for the tasks at hand." But this seemingly calamitous statement must be tempered by a finding:

> Although as late as early 1968 there were some unfilled requirements, no instance was found in which a logistic activity was degraded to the extent that it restrained important military operations. (3:7)

This article is not intended as a condemnation of the views of Major Dilla. Instead, I have tried to use Dilla's article as a case study for both documenters and later researchers to suggest all aspects of a problem must be specified and studied. It is appropriate that Desert Shield/Storm be examined in excruciating detail to substantiate successes which can be incorporated into logistics doctrine and to identify problems which must be worked. In both cases, however, the political, economic, and military strategy and tactics that affected the results must be noted so we do not try to duplicate a success from one environment into a totally different environment. Also, it is necessary so future logistics historians do not become revisionists for lack of background material.

A second caution for publishers of strong disparaging essays on logistics: Try to obtain a second historical opinion in support of or against the essay. The logisticians of today need to understand the differing views of the past so they can properly apply lessons learned.

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Whatever Happened to R&M? Nothing, It's Alive and Working

General Charles C. McDonald, USAF
Commander, AFLC

During the Cold War, the defense posture of the United States was based on countering a numerically superior foe. Today, that posture has taken on a new dimension. We must not only be able to counter superior numbers, but we must be flexible enough to reach out quickly to any location in the world to respond to regional crises such as Iraq's invasion of Kuwait.

One constant ingredient is required to win in either environment—highly reliable and maintainable weapon systems that afford us the ability to strike again and again. Reliable weapon systems result in increased combat capability requiring fewer spare parts and less manpower. Maintainable systems require fewer people and specialized skills and reduce maintenance time and costs.

In recent years, the Air Force principles of reliability and maintainability (R&M) have become force multipliers unequaled anywhere in the defense aerospace industry. When a new system takes shape on the drawing board, R&M is no longer an afterthought; it is part of the design and planning.

And each time a system is upgraded or modified, R&M is inserted. For example, a major radar modification to the F-15 is underway at the Warner Robins Air Logistics Center, Robins AFB, Georgia. The program will ensure long-term supportability of the F-15 by eliminating the present nine line replaceable units, or "black boxes," which are becoming unsupportable due to parts obsolescence. They will be replaced with six state-of-the-art units that will be more reliable and maintainable.

At the Oklahoma City Air Logistics Center, Tinker AFB, Oklahoma, each KC/C-135 will have 20% of its nearly nine miles of wiring replaced as it goes through depot maintenance. The new wiring will be more reliable as it will replace wiring that was installed during aircraft production from 1957 to 1966.

For further proof positive, we need look no further than Operation Desert Storm. The Gulf War was a virtual showcase of R&M successes:

— Our aircraft flew 65,000 sorties during Desert Storm and maintained a mission capable rate of 92%. That is R&M.

— The F-15E alone flew 2,200 sorties with a 96% mission capable rate.

— An F-111 wing commander reported his unit flew 2,100 sorties with not one aircraft exceeding its scheduled maintenance time.

— Despite being over 30 years old, the B-52 showed its R&M by flying 1,600 sorties with a mission capable rate of 81%.

But the benefits of R&M extend beyond the weapon platform. Improved R&M reduces dependence on large combat support structures, thus improving the survivability and sustainability of the fighting force. Good R&M has improved the mobility of our forces because there are fewer people and less support equipment and spares to move.

Desert Storm was again a prime example. F-15s were sitting on alert ready to fly defensive patrols along the Iraqi-Saudi border, 7,000 miles from home bases, within 38 hours of notification to deploy.

And we are getting better. While it requires 17 C-141s loaded with supplies and equipment to deploy a 24-plane squadron of F-15s, a squadron of new F-22 fighters will need only eight planeloads. Also, the total number of people needed to support an F-22 is 15, down dramatically from the 25 needed to support every F-15. But most importantly, we project the F-22 will fly 8.5 combat sorties between major maintenance actions, up from the 5.4 rate of the F-15.

R&M has come from a common sense, logical concept of a few years ago to an Air Force and industry partnership that has made the United States Air Force the best-supported, most reliable air power in the world.

But prior to the "R&M revolution," the outlook was bleak. In the early 1980s, we were weighed down by a growing maintenance burden. More than one-third of Air Force manpower was devoted to maintenance. We treated R&M like optional equipment—nice to have, but secondary in importance to the overall product.

Logisticians argued for a cultural change they hoped would make R&M a natural, automatic aspect of our day-to-day business. This R&M movement gained momentum in 1985 with the birth of R&M 2000.

The R&M 2000 program had five simple goals: (1) increase combat capability; (2) decrease the vulnerability of the combat support structure; (3) decrease mobility requirements per unit; (4) decrease manpower requirements per unit of output; and (5) decrease costs.

To ensure that sound maintenance principles were built into the front of the acquisition process, the R&M 2000 charter stated that R&M would be equal to cost, schedule, and performance requirements in the weapon system acquisition process.

But some of our first experiences with enforcing R&M were challenges. For example, when the LANTIRN night vision and navigation pod was tested in 1985, it had good performance, but low reliability. The Air Force went back to the contractor and told him he needed to meet certain reliability goals before he could proceed to the next phase of the contract. He went back to the drawing board and made some design changes; and, a few months later, the program was back on track.

And it paid off. In Operation Desert Storm, the 72 LANTIRN pods deployed had an amazing mission capable rate of 98%.

The weapon systems in design and production today will be even greater R&M success stories. The B-2 bomber is already a classic example. Throughout the design, development, and testing of the B-2, R&M has been as important to the program as the plane's composite makeup and its stealth capabilities. An aircraft's stealth technology is relatively ineffective if that aircraft is not maintainable and reliable when it is time to perform its mission.

Early in the B-2 program, logisticians helped establish many maintainability design requirements and our contractors responded with products dedicated to the original R&M 2000 goals.

Aircrews and maintainers alike will appreciate the B-2's computerized on-board test system which monitors aircraft performance, detects and isolates component failures, and produces data on the failures. This means a need for less technical data, less maintenance training in lengthy diagnostic procedures, less support equipment, and less manpower.

In place of traditional printed paper products, maintainers will have needed information at their fingertips with the B-2's integrated technical data system. This hand-held electronic device provides accurate and complete technical data with speed and mobility. No longer will maintainers have to lug around an armload of technical manuals or laboriously keep them updated page by page.

Even the simplest ideas will save countless man-hours of maintenance. For example, B-2 components requiring frequent maintenance are easily accessible. This means less time spent by maintenance people removing several good parts to get to a problem part.

As a result, our early data indicates the B-2's maintenance man-hours per flight hour will be less than 34.5, far better than our original requirement of 50.

But our emphasis on R&M is not limited to the weapon systems program offices and the production lines.

Two joint Air Force Logistics Command—Air Force Systems Command offices at Wright-Patterson AFB, Ohio, are continually adding to the list of good R&M ideas. The Productivity, Reliability, Availability and Maintainability (PRAM) Program Office is responsible for inserting mature, off-the-shelf technology into existing weapon systems, support equipment, and maintenance depot operations. The Reliability and Maintainability Technology Insertion Program (RAMTIP) Office focuses on new, emerging technologies that can be applied to both developing and existing systems.

One of PRAM's most recent successes is the fielding of a "video fax" machine that allows field maintenance technicians, when necessary, to relay video images via fax machine back to our depots where engineers can assess aircraft damage and quickly develop repair processes to get the aircraft flying again. This video fax capability will save hours and even days in exchanging drawings and photographs explaining the extent of an aircraft's damage and the repairs needed.

Without the video fax, a unit must prepare a written message describing the damage. If the message cannot adequately describe the damage, the depot may request photos and X rays. If it is still not clear as to what repair steps should be taken, depot engineers will have to travel to the site of the damaged aircraft. Not only is the process time consuming, but it can be costly in man-hours and resources. But more importantly, it means there is an aircraft that cannot perform its mission.

Three video faxes were deployed and operated in Saudi Arabia. Maintenance crews there were extremely pleased with this new capability.

Working with Warner Robins Air Logistics Center, RAMTIP is developing a program for repairing aluminum aircraft structures with epoxy composite materials. The composites will prevent crack growth, require less repair time, and significantly reduce corrosion problems at the repair site. This process is expected to shorten repair time from six weeks to two weeks and increase aircraft availability. The composites will be used initially on the C-141 and C-130 and used later on most aircraft in the Air Force inventory.

These are just two of many examples that add up to meet the overriding R&M goal of increased combat capability.

And to manage our ever-growing wealth of R&M information, AFLC has developed the Reliability and Maintainability Information System (REMIS). REMIS is the standard Air Force computer system for collecting, processing, and analyzing R&M data. REMIS will increase readiness and sustainability of our weapon systems by improving the availability, accuracy, and flow of essential maintenance information. Computers at AFLC Headquarters and each of our five depots will collect and organize maintenance information for every Air Force weapon system. The information will then be made available through REMIS to some 1,800 current users worldwide.

Another initiative that will strengthen R&M is the integration of AFLC and AFSC to form the new Air Force Materiel Command. The cornerstone of the integration is Integrated Weapon System Management. This cradle-to-grave management concept allows for a single system program office to be responsible for the entire life cycle of a weapon system. There will no longer be a "handing off" of a system from AFSC to AFLC. This single-manager approach will further strengthen and institutionalize our R&M initiatives by eliminating cultural differences that existed between the research and development and logistics communities in years past.

These cultural differences were dictated by the very nature of the commands' missions. For example, AFSC, with its research and development role, was always at the leading edge of technology, designing the weapon systems of the future. Conversely, AFLC, in its support role, was called on to use its "less-glamorous," but no-less valuable, technologies to sustain weapon systems once they joined the inventory. As a result, logistics principles were not always engineered into emerging systems.

With the formation of AFMC, we will have a "seamless" organization and a new culture that ensures R&M will continue to be a top priority.

We have also made tremendous R&M strides in academia. R&M is an important part of the curriculum for our engineering students at the Air Force Institute of Technology, Wright-Patterson AFB, and other Air Force educational facilities. Our engineers of tomorrow are leaving their classrooms with an appreciation for sound R&M basics.

An objective of the early R&M 2000 campaigns was a call for institutionalizing the R&M mindset. Brigadier General Frank S. Goodell (Ret), then Special Assistant for Reliability and Maintainability at Headquarters United States Air Force, said in 1986 that his role was to institutionalize R&M to the point that his organization at the Pentagon would go out of business.

His goal has been realized as his former office is now being dissolved. Air Force leadership has declared victory in our efforts to institutionalize R&M.

The examples I have cited clearly illustrate the tremendous progress we have made in recent years. Our weapon systems are more reliable and maintainable today than at any time in history. The systems of tomorrow, such as the F-22 and B-2, will be even more dependable.

The search for increased R&M must be continuous. We have not, and must not, lose our focus on R&M. The closure of the R&M office at the Pentagon represents a milestone in our efforts to institutionalize it. However, only when every one of our design engineers, scientists, logisticians, acquisition specialists, maintenance technicians, and system program managers has sound working knowledge of, and appreciation for R&M, will it be truly institutionalized. Until that day arrives, we must continue to improve our processes, emphasize quality, and be creative at every level of our day-to-day business.

Our world has changed dramatically in the past two years. The Cold War has ended and the Soviet threat has diminished. Consequently, our defense dollars are becoming leaner. Fewer of today's aircraft will be needed and we will be buying fewer in the future. With less money for maintenance and support, our remaining aircraft will have to be more reliable and maintainable.

This is why we must always look for new and better ways to design, build, and support our weapon systems. We can accomplish this by remaining focused on R&M. By doing so, we can continue to push the art of the possible.

86th Fighter Wing Reorganization Test

Lieutenant Colonel Eugene F. Leach III, USAF

This is the first of many Journal articles which will discuss the changing structure of the maintenance wing. Keep in mind that this article includes only the events which took place in a 120-day time frame (March - July 1991) at Ramstein Air Base. The final structure of the maintenance wing is still being studied and awaits approval by General McPeak.

What if you were asked to reorganize your current wing organizational structure to:

- align resources and responsibilities with appropriate commander for both day-to-day and combat operations?
- replace functional perspectives with command responsibilities?
- delayer and streamline organization?
- posture for a composite force?

The 86th Tactical Fighter Wing (TFW) at Ramstein Air Base, Germany, was faced with just such a challenge and then asked to test the new organization. What follows is the background leading up to the reorganization test implementation and how we are performing at this point. So just how did this reorganizational challenge begin?

Background

The reorganization concept was briefed at the February Corona South 91 conference. Ramstein was chosen as one of 12 test locations, and each major operational MAJCOM was to be a player. The 86th was tasked, on 5 March 1991, to build an initial grassroots proposal using copies of the Corona slides as a guide. Since the slides came without any instructions, we were on our own in designing a new wing organizational structure which would be streamlined and workable. Additionally, we were under a very tight time line because the Commander in Chief (CINC) had to brief General McPeak, Chief of Staff of the Air Force, on 22 March 1991. Between 5 and 21 March, we briefed the new organization to the Seventeenth Air Force Commander and his staff, the HQ USAFE staff, and the CINC. On 22 March we briefed General McPeak who approved the proposed structure for testing with implementation to begin in early summer.

Two separate taskings were actually involved in the test. The first was to deactivate the 316th Air Division (AD), the parent 86 TFW organization, and then merge the 316 AD, 377th Combat Support Wing (CSW), and the 86 TFW into a new single wing, the 86th Fighter Wing, under one wing commander. Concurrently, a reorganization into a "Group(s) Structured Wing" was also to take place. Herein lies the heart of the maintenance and operations reorganization and this article.

Reorganization

First, we replaced the time and combat-proven tri-deputy structure (DCM, DCO, DCR) with Operations and Logistics Groups (Figures 1 and 2).

Then, we proposed additional organizational changes within each of the new groups. For instance, we suggested that the Operations Group include an Operations Squadron (which basically replaces the old DO staff) in addition to its flying squadron (Figure 3).

Next, we made several changes to the original Corona proposal (Figure 4). Starting from the top, STAN EVAL/QA works directly for the commander to avoid possibly compromising the objectivity of the evaluators. We changed the name of the Flying Support Squadron to the Operations Support Squadron (OSS); i.e., Operations Group . . . Operations Support Squadron. Comprised of parts of the old DCO and DCM staffs, we believed it feasible to combine similar functions (plans, scheduling, command and control centers, etc.). The wing plans function (DOX) and maintenance combat plans have integrated, as have the old DCM and DCO scheduling functions. Other DCM staff functions, as shown, were also moved to the Operations Group. The "rule of thumb" was, if individuals had an on-equipment Air Force specialty code (AFSC), they went to the Operations Group; if they had an off-equipment AFSC, they went to the Logistics Group.

Now, let's go one step further and look at the composition of the new Fighter Squadron (FS). As shown in Figure 5, an FS now contains its own maintenance capability and with it the Aircraft Generation Squadron vanished. A senior maintenance officer (lieutenant colonel) will head up this organization. Sortie generation is basically handled by the Aircraft Maintenance Unit (AMU) which previously belonged to the Aircraft Generation Squadron. Sortie support combines the AMU supply function, Dedicated Aircraft Supply Support (DASS) in USAFE, the previously assigned Equipment Maintenance Squadron AGE, the Combat AGE Team (CAT), and Aircraft Phase Inspection into one section also assigned to the FS. For the test period, we proposed "VEH" as dedicated, on-call (during flying hours) mobile vehicle maintenance trucks.

The Corona slide presented the Logistics Group structure as shown in Figure 6; however, we found this structure to be unsuitable for Ramstein. Our counter proposal is illustrated in Figure 7.

The most obvious change was not having an Asset Management Squadron (AMS). However, we retained Supply and Transportation as separate squadrons because of their size and missions. *Supply*, with over 400 people and approximately 85% of its mission supporting units other than the 86 FW, and *Transportation*, with over 350 people, 2,900 vehicles, and most of its mission devoted to units *other than* the 86 FW, should not be combined. Additionally, the Test Measurement and Diagnostic Equipment (TMDE) section (Precision Measurement Equipment Laboratory) in the 86th which supports the entire European Theater, calibrating/testing over 26,000 pieces of equipment a year, needed a home. Finally, Avionics would "fit" into the Equipment Maintenance Squadron (EMS) better than with the others in the AMS. As mentioned, the Support Squadron replaced the applicable Deputy Commander's staff and with the Logistics Support Squadron (LSS) herein lies the remainder of the DCM's staff . . . plus a few others. Their charter was to

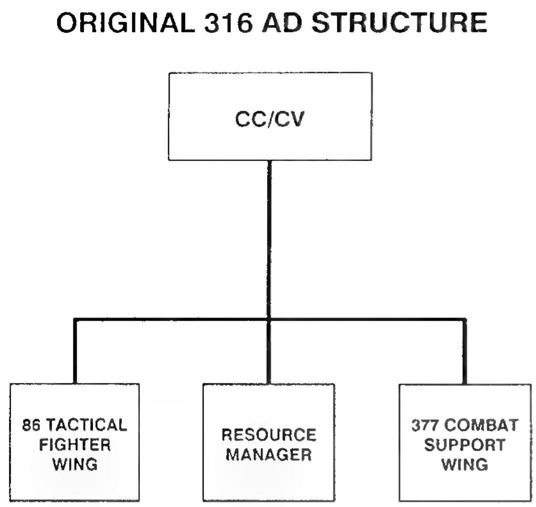
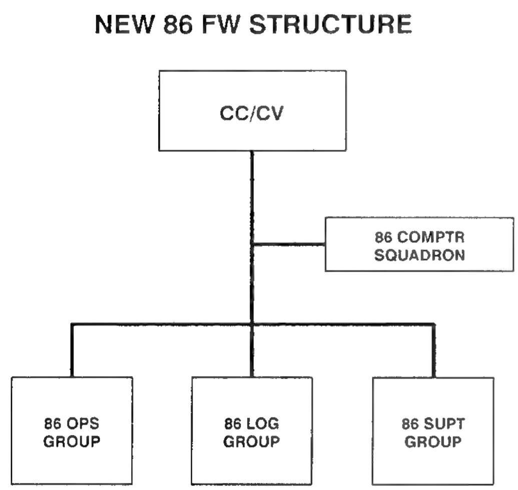


Figure 1.



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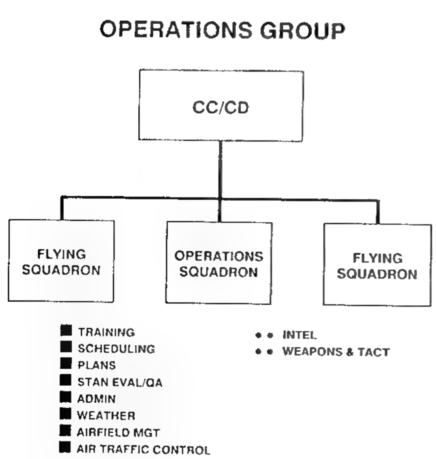

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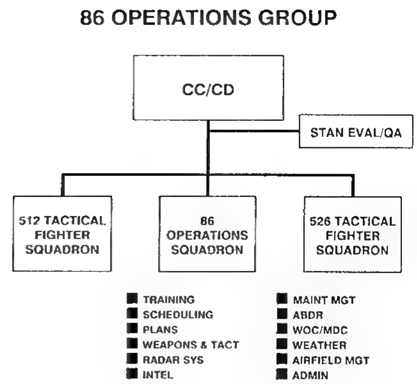

Figure 4.

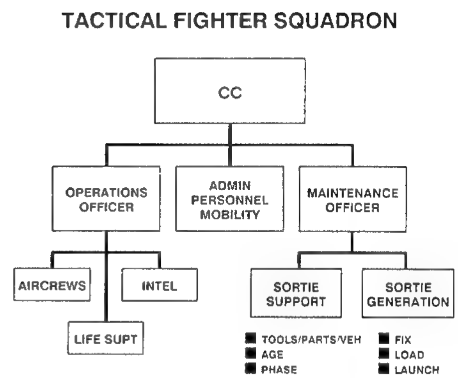

Figure 5.

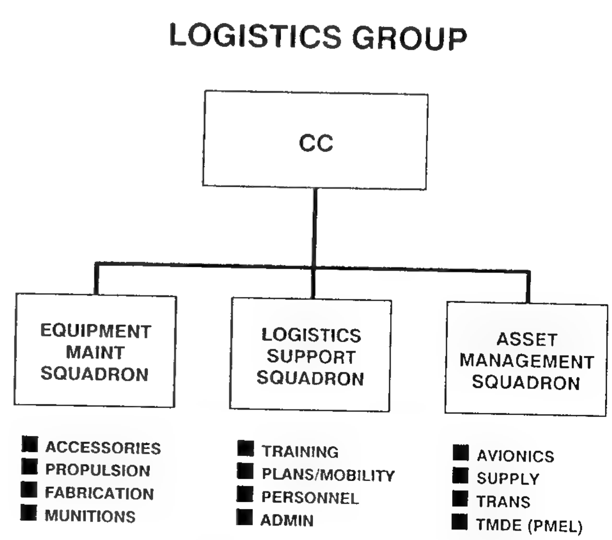

Figure 6.

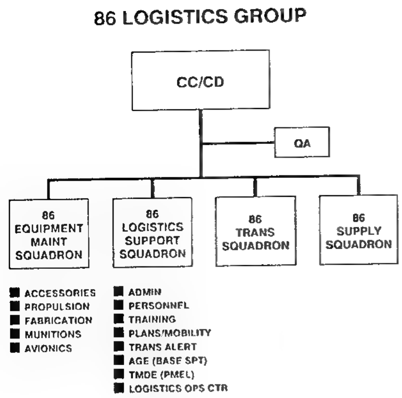

Figure 7.

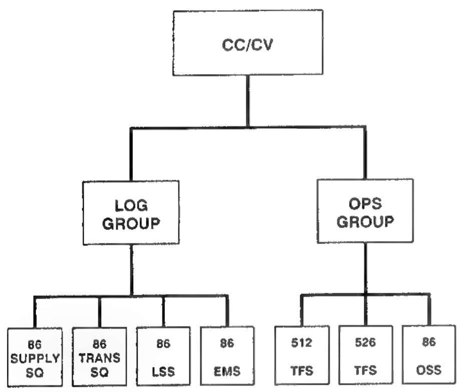

Figure 8.

support the rest of Ramstein, thus we put Transportation Alert (TA) and the 86 CAT (AGE Base Spt), as well as TMDE, in the LSS, again because of the uniqueness of Ramstein. With HQ USAFE, plus a large Military Airlift Command (MAC) transit commitment, TA is purposely divorced from the daily flying effort of the 86th Operations Group so as not to compete with or impact their mission. The AGE needed to support TA as well as the rest of Ramstein AB (Prepositioned Procurement Package and War Reserve Materiel) which is contained in the 86 CAT. TMDE at the 86th provides both a regional and theater calibration support depending on what equipment is being worked. Finally, the Logistics Operations Center is the Logistics Groups' version of the Maintenance Operations Center (MOC). Currently, in the "concept stage," we are evaluating what makes the most sense for us. In summary, the Operations and Logistics Groups are organized as shown in Figure 8.

Implementation Schedule

Now we'll address the proposed implementation schedule. As shown in Figure 9, we were leaning forward because approval for this test was given on 22 March.

Although a 30-day phase-in period was envisioned, all reorganization actions took place on 1 May. The transition went very smoothly, due in large part to the detailed and in-depth planning of the wing reorganization working group. They carefully reviewed building floor plans (must house everyone at

IMPLEMENTATION SCHEDULE

BUILD NEW UMD	IN PROGRESS
PREPARE REORGANIZATION ORDERS	IN PROGRESS
FINALIZE ACTIVATION PLAN	COMPLETE
ACTIVATE NEW 86 TFW STRUCTURE (INACTIVATE 316 AD AND 377 CSW)	1 MAY
ACTIVATE OPS, LOG AND SUPT GROUPS (ELIMINATE RM FUNCTION)	1 MAY
ACTIVATE OPS AND LOG SUPT SQUADRONS. REALIGN FIGHTER AMUs TO FIGHTER SQUADRONS	NLT 1 JUN

Figure 9.

EVALUATION OF TEST WING

TEAM CHIEF 86TFW/CV WITH BOTH
86TFW AND USAFE STAFF MEMBERSHIP

TIMETABLE

PERIOD	
45 DAYS	INITIAL REVIEW OF WING REORGANIZATION
BI-MONTHLY	REVIEW OF REORGANIZATION
9-MONTH	COMBAT ASSESSMENT OF REORGANIZATION FOCUSING ON WAR FIGHTING (1 MAR)

MEASURES OF MERIT

MC RATE	SCHEDULING EFFECTIVENESS	TNMCS RATES
BOMB SCORES	OPR/EPR TIMELINESS	TAC/EVAL

Figure 10.

no cost), to reallocation of furniture, computers, and vehicles, to working closely with the Communications Group for virtually uninterrupted phone service. Furthermore, a well-thought-out and timely published wing "P-Plan" allowed all to have a guide for "the what's next" or, at least, know the particular group point-of-contact. As mentioned, the 86 FW was chosen to test this new organizational structure. Part of any test undertaking is an evaluation of the test. We are doing just that, as shown in Figure 10.

Measures of Merit

The measures of merit (MOMs) are by no means all inclusive. Each squadron has developed MOMs to gauge the pluses and minuses of reorganization. These will be the true basis for the test evaluation. Having just completed the 45-day test, the prime concerns were:

OPERATIONS GROUP

- There is insufficient rank/experience of maintenance supervision at Operations Support Squadron level.

- Fighter squadron maintenance officer professional development is uncertain.

- The Operations Group does not own all the resources associated with direct sortie production.

- There is some confusion over span of control as staff functions have been realigned and streamlined.

Continued on bottom of page 27

USAF Logistics Policy Insight

Essential Contractor Services

Contractors support vital systems and perform many base support operations essential to the US mobilization and wartime missions. Under DODI 3020.37, activities relying on contractor support will identify essential contractor services, assess the impact of the loss of contractor support, and include the results of these assessments in contingency plans. Commanders and chiefs of functional activities, now more than ever, need to take an active role in acquisition strategy development and provide for reasonable assurance of continuation of essential services during crises. AFR 28-3, *USAF Operation Planning Process*, provides policy and checklist items applicable in writing contract requirements and planning alternatives to contract support. (Lt Col Brad Orton, SAF/AQCO, DSN 224-1732)

Contingency Contracting

Operation Desert Shield/Storm underscored the need for unit commanders to include contingency contracting officers with the earliest arrivals into deployed locations to establish contract sources to support the unit. AFRs 70-7, *Contingency Contracting Support Program*, and 28-3 provide detailed policies to ensure that contracting support is fully addressed in the planning process. A contingency contracting capability is also established which provides contracting resources that can be called up by a deploying unified command contracting authority to participate in site surveys, work host nation and centralized contract arrangements, and augment beddown activities ahead of deploying forces. (Lt Col Brad Orton, SAF/AQCO, DSN 224-1732)

Local Purchase Requisitions

Beginning with Fiscal Year 1992, the Air Force initiated a three-phase test which increases the wing commander's flexibility in the area of local purchase requisitions. Phase I runs from 1 October 1991 through 30 September 1992 and covers purchases for non-aircraft, non-missile consumable items. Under the test, the commander evaluates cost, quality, and responsiveness for consumable items related to aerospace ground, support, and communications-electronics (non-weapon systems) equipment and vehicles. Phase II will run 1 October 1992 through 30 September 1993 and will include non-aircraft and non-missile stock funded reparables. Based on the results of Phases I and II, Phase III will begin 1 October 1993 and include aircraft and missile items which are not flight safety critical. (Maj Rita Torner, HQ USAF/LGSS, DSN 225-4895)

Cargo Movement Operations System

The Cargo Movement Operations System (CMOS) is the most significant enhancement to Air Force transportation, perhaps logistics, under development today. Many base level activities are already seeing the introduction of CMOS with the installation of Local Area Networks (LAN) and the receiving of hardware necessary to operate the system. CMOS is being developed in three increments:

(1) Increment 1, already coded and in testing, automates base level TMO activities and provides an electronic interface with base supply. Completion of Increment 1 is slated for December 1991.

(2) Increment 2, which adds mobility processing to CMOS, has passed the design phase and is currently being written. With completion of Increment 2 (June 1992), the distinction between peacetime cargo and wartime cargo will be eliminated.

(3) Increment 3 takes the next logical step and ties CMOS with a number of other Air Force and DOD logistics systems. Included in this increment is a merger with the Military Airlift Command's (MAC) ADAM-III system which further automates the aerial port documentation system. The completion of Increment III will provide a seamless logistics network and give base level users complete intransit cargo visibility. (Maj Wasem, AF/LGTX, DSN 227-7332)

Elimination of the "M" Account

Funds appropriated by Congress are available for new obligations for a specified period of time. The time periods for

Continued from page 26

- Fighter squadron facilities are not adequate to house new functions. There is insufficient room to integrate maintenance activities.

- Higher headquarters are not organized to support the Operations Group concept. The HHQ DO/LG organizational structure does not provide optimum support to a group level subordinate unit with elements of both operations and maintenance in the same group.

LOGISTICS GROUP

- Logistics officer professional development is uncertain.

- Alignment of the logistics plans activity within the LSS lacks visibility and does not initially seem compatible with LGX's many wing-level responsibilities.

Summary

Approximately 120 days ago, the 86th was challenged to test a new reorganizational concept. We developed a new group structured model, based upon a "BOTTOM UP" approach, where the actual players provided direct input. Then, the test organization was implemented ahead of schedule in a relatively smooth manner. Looking ahead, in the final analysis the key ingredient to this process will be maintaining flexibility to make "mid-course corrections" and a thorough evaluation coupled with honest feedback on how we are "doin."

Lt Colonel Eugene F. Leach III is Logistics Group Deputy Commander, 86th Tactical Fighter Wing, Ramstein AB, Germany.

Air Force appropriations are: 1 year for operation and maintenance (O&M); 2 years for research, development, test and evaluation (RDT&E); 3 years for all procurement (aircraft, missile, and other); and 5 years for military and family housing construction. Prior to the FY91 National Defense Authorization Act, 5 November 1991, balances obligated at the end of these availability periods entered an expired period for 2 years and were then transferred to the "M" Accounts. They remained available to pay "within scope" upward adjustments and reprocurements.

The Act directed elimination of the "M" Accounts over the next 3 years and redefined how appropriation accounts are canceled and closed. The law canceled the merged accounts which fund the obligations but did not relieve the Government from its legal liability to pay the obligations. It applies to all appropriations and cannot be waived.

All "M" Account *unobligated* balances have been canceled. All "M" Account *unexpended (unpaid) obligations* which were in the "M" Account for more than 5 years have been canceled. At the end of FY91 and FY92, remaining unexpended obligations which have been in the "M" Account for more than 5 years will be canceled. At the end of FY93, all remaining balances in the "M" Accounts will be canceled and "M" Accounts will cease to exist.

Currently, appropriations remain available for new obligations during the current period after which unexpended obligated and unobligated balances transfer to expired status where they remain for 5 years (as opposed to 2 years under the previous law). After the 5-year expired period ends, all balances are canceled and cannot be restored. Upward obligation adjustments and payments required against a canceled obligation then must be funded using current appropriations.

Under the new law, obligation of funds no longer protects them from cancellation; they must be expended. Expenditure, however, cannot happen until obligations have occurred. To minimize the impact on current year funds, it is important that emphasis be continued on quick obligation of funds and, in addition, increased emphasis must be placed both on expending funds once they are obligated and also on quick contract cleanup/deobligation of funds when no longer needed on a contract so they can be reprogrammed and obligated/expended on other Air Force requirements.

AFR 57-9

The logistics requirements for new or improved systems usually evolve from general long-range planning guidance to a mission need statement and, ultimately, a more detailed operational requirements document. Using inputs from the implementing, supporting, and testing organizations, the operational commands have primary responsibility for developing the overall system operational requirements, to include readiness and logistics supportability.

A new regulation, AFR 57-9, *Determining Logistics Supportability and Readiness Requirements*, gives specific guidance on how to develop these parameters for inclusion in operational need, requirements, and concept documents. It furnishes definitions for readiness-related terms, describes the integrated logistics support elements, and provides users with a basic framework to start with to bound both qualitative and quantitative requirements. Its purpose is twofold: to specify the basic logistics terms to be used during this process and to describe the parameters that should be initially considered—then tailored as appropriate—when defining the operational need. The more clearly these needs are expressed, the more likely the user will get systems that are available, reliable, and supportable once deployed. (Maj Gloria Jenkins, AF/LGMM, DSN 227-5158)

Pollution Prevention

The Air Force Pollution Prevention Program (PPP) implements the Pollution Prevention Act of 1990, signed into law in November 1990. The Air Force is committed to being a national leader in protecting and enhancing the environment by preventing pollution wherever possible. Environmentally harmful discharges to the air, land, surface water, and ground water will be prevented at the source to the greatest extent possible. Pollution prevention practices will be pursued at all installations and in all acquisitions, operations, and maintenance programs since pollution prevention is more desirable than waste management and pollution control.

Our priority is to reduce waste at the source; wastes that cannot be eliminated will be recycled in an environmentally sound manner. Wastes that cannot be recycled will be treated. Disposal, or other releases, will be used only as a last resort. Where the alternatives to hazardous materials have been considered and the use of hazardous materials cannot be avoided, hazardous materials shall be selected, used, and managed over their life cycle so DOD incurs the lowest cost required to protect human health and the environment. Hazardous material selections will be based on the cost factors associated with the complete life cycle of the hazardous material.

The Air Force Logistics Command (AFLC) is a primary player in the Pollution Prevention Program with emphasis being placed on the Air Logistics Centers to eliminate the use of hazardous materials through substitution or alternative processes and to reduce the generation of hazardous wastes to as near zero as feasible. The Centers are also involved in the review of technical orders (TOs) and MILSPECs to eliminate the required use of hazardous materials in the operation and maintenance of weapon system and support equipment.

The System Program Offices (SPOs) will also play an important role in pollution prevention through the Acquisition Management of Hazardous Materials program which uses life cycle cost modeling to determine the economics of using hazardous materials in the weapon systems. (Mr Jeff Short, CEVV, DSN 297-0276)

Supporting Commercial Systems

Robert G. Olear

Background

In 1989 the United States Air Force formally began work on development of policies and procedures to improve support of commercial equipment and systems. Senior acquisition commanders wanted to reduce support development time and capture the successful procurement and logistics practices being developed independently by major commands.

Speed was becoming a pressing issue. Commercial systems could often be purchased and deployed much faster than developmental systems. But creating and employing successful support for them was more difficult. In fact, many systems could be fielded before total support could be provided. The major support limiters included spares, support equipment, and sustained integration.

Moreover, they were convinced they had smart people working for them—people who had solved all or part of the problems which can lead to slow or difficult support. The problem, from their perspective, was that those smart solutions had not been captured or institutionalized so others could benefit. Their desire was to get all their people smart at once, thereby improving the entire acquisition logistics process.

This led to formation of a Commercial Off-the-Shelf (COTS) Supportability Working Group. Leadership of this group was given to Richard Bleau, Electronic Systems Division (ESD/AL)/Acquisition Logistics Division (ALD/OE). His group was tasked initially to "address COTS problems from the requirements, acquisition, and support perspectives, and to develop long overdue COTS policy and guidance." (1) Specifically, the team would "review industry practices; capture the best government approaches; draft new policy and procedures; and obtain joint command coordination." (2)

The purposes of this article are to document the history of the COTS Supportability Working Group, to examine the progress that has been made by the group, and to review the tasks that remain.

COTS Defined

Before we detail the origins of the COTS Supportability Working Group, let's examine what is normally meant by COTS. To do that, we will break down the phrase into two basic components: commercial and off-the-shelf.

Commercial items are items, including computer software, regularly used for other than government purposes which, in the course of normal business operations:

. Have been sold or traded to the general public.

. Have been offered for sale to the general public at established prices but not yet sold.

. Although intended for sale or trade to the general public, have not yet been offered for sale but will be available for commercial delivery in a reasonable period of time.

. Are described in the preceding three bullets and would require only minor modification to meet the requirements of the procuring agency. (4)

Off-the-shelf "means an item produced and placed in stock by a contractor, or stocked by a distributor, before receiving orders or contracts for its sale." (FAR 46.101)

These definitions come from the Federal Acquisition Register (FAR) but fail to address the interrelationships and impacts of support, environment of use, skill and availability of maintainers, and configuration management. As will be explained, that deficiency is critical. In fact, the Working Group was forced to spend a lot of time on basic definitions, just to ensure all participants were committed to a common task. In so doing, it was necessary to offer some new and revised definitions to handle the supportability aspects of COTS acquisition.

Formation of the COTS Supportability Working Group

AFCC Letter. On 30 January 1989, the Air Force Communications Command (AFCC) Deputy Chief of Staff for Logistics sent a letter to HQ USAF/LEYM (Maintenance Policy Division). That letter pointed out the growing disconnect between the time required to obtain and field COTS systems, and the time required to develop and employ the essential logistics support tail.

AFCC cited a causal trail for this disconnect:

> COTS vendors will not provide the proprietary engineering data necessary to support the provisioning process and the establishment of an organic depot repair capability. Consequently, COTS/NDI (nondevelopmental item) spares are not catalogued and incorporated into the Standard Base Supply System (SBSS). As a result of this situation, the Air Force has fielded COTS/NDI equipment without: (a) the proper life-cycle logistical support, (b) addressing the issue of blue-suit maintenance of wartime critical deployable COTS/NDI, and (c) the manpower authorizations to provide such support.

The letter cited a lack of COTS acquisition guidance and the belief that development of coordinated Air Force policy and procedures was imperative. To achieve that aim, AFCC recommended that HQ USAF/LEY (Maintenance & Supply Directorate) convene a conference of "COTS/NDI users, supporters and acquirers in the May-June time frame." (8)

Joint Commanders Conference. The meeting of the Joint Logistics Commanders (Air Force Systems Command (AFSC) and Air Force Logistics Command (AFLC)) in March 1989 provided a second impetus for the Working Group. At this meeting, Bleau presented a briefing on COTS supportability concerns, titled "Commercial-Off-the-Shelf (COTS) Items: The Supportability Challenge." In his briefing, he stressed two major concerns:

(1) Increased use of COTS presents both unique opportunities and problems for implementing and supporting commands.

(2) The challenge in addressing these opportunities and problems is made more difficult by the absence of command-level policy and direction for acquiring and supporting COTS equipment. (3)

The commanders agreed that the issues raised by Bleau required study and resolution. In April 1989 they directed formation of a "team composed of AFSC, AFLC, ATC (Air Training Command), AFCC, and the using commands to develop COTS policies and procedures for managing pure COTS; modified COTS; and COTS requirements." (3) Offices of primary responsibility (OPR) were AFLC/MM, AFSC/PL, and AFALC/CC. (NOTE: AFALC (Air Force Acquisition Logistics Command) became ALD, Acquisition Logistics Division (now deactivated); AFSC/PL is now AFSC/EN.)

All Command Working Level Conference. The next step in the process was to gather representatives of all commands. This was done 13-15 June 1989. The conference was a logical and necessary meeting, since no one command or group of commands (acquisition, supporting, operating, participating, etc.) by itself determines successful support. Since good policy and procedures can never be formed in a vacuum, the senior acquisition executives realized the enthusiastic participation of all would be required. And the best way to generate that enthusiasm would be to build upon the theories and proven practical approaches of those who had been working on improvements in the COTS acquisition logistics process.

Chaired by HQ USAF/LEYM (Lieutenant Colonel John Paul Clarke), and hosted by the Sacramento Air Logistics Center (SM-ALC), the conference had two stated objectives: (1) to identify systemic problems in COTS acquisition and (2) to validate a COTS Handbook drafted by William Millard of SM-ALC.

Problems identified by the group covered a broad spectrum:

(1) Sources and levels of repair.

(2) Training for "blue-suit" operators and maintainers.

(3) The nature and integration of Interim Contractor Support (ICS).

(4) Integration and use of the SBSS.

(5) Adequacy and availability of technical data.

(6) Leadtime for establishing logistics support.

(7) System replacement planning factors.

The major undertaking of the conference, however, was validation of Millard's draft COTS Handbook. This was an extremely important compilation of advice for the acquirer of commercial systems and embedded commercial subsystems. Written as a guide to intelligent decision-making, and based on the premise that "intelligent" people carefully consider all options before acting, the handbook represented years of effort and original thinking. It emphasized the need to consider total life cycle costs when buying commercial items and used a decision-tree approach to determine whether or not COTS should be acquired. Finally, it contained "myth-busters" designed to point out various commonly-held fallacies regarding COTS.

The conferees examined the handbook in three subteams, eventually endorsing its approach and compiling suggested improvements that would be incorporated into the final draft. That draft was eventually submitted to SAF/AQXA (Acquisition Policy) for publication as an Air Force Pamphlet.

At the conclusion of the conference, it was announced there would be a follow-on working group, chaired by HQ ESD/PLL. This group would later be named the COTS Supportability Working Group.

Group Inception

Formation. On 29 December 1989, the charter for the Working Group was approved. It laid the foundation for a team that would focus its "efforts on all aspects of COTS." Emphasis would "be directed towards identifying the supportability challenges associated with commercial off-the-shelf items which face the implementing, supporting, participating, and using commands." Deliverables of the group would be recommended "policy, guidance, and procedures that improve the selection, integration, and support of COTS (to include both computer and non-computer items) for Air Force systems and equipment." (6)

To provide those deliverables, the group was tasked to:

(1) Identify supportability challenges facing implementing, supporting, participating, and using commands.

(2) Visit Air Force and private industry to get their perspective, approaches, and procedures on both effective and ineffective support practices.

(3) Verify data collected through on-site visits where practical.

(4) Provide briefing and final report to the AFSC, AFLC, and AFCC commanders. The final report shall contain specific recommendations for policy and procedural changes. (6)

Definition. To preclude confusion, the charter defined COTS in this way:

> A commercial-off-the-shelf item is a commercial hardware/software item which has not been modified by the government, is in the commercial inventory or production, has proven its performance in a similar environment, has an existing support structure, has an internal configuration which flows with commercial changes, and generally is integrated with other hardware/software items to become part of a system or subsystem capability.

This was in fact an excellent definition, since it referenced the key problem areas which had been limiting the support effectiveness of COTS acquisitions. These problem areas would be addressed by the group; and their efforts to eliminate/minimize the effects of the problems would eventually lead to a final; generic redefinition.

Opening Round. It became quickly apparent, as the group got together for the first time, that achieving a common set of terminology and meanings would be one of the more daunting tasks. As the group met from 23-25 January 1990, perceived differences in experience and requirements led to lengthy discussions about what the true focus of the group should be.

But this was not a new experience, since the same battle for common ground had taken place previously at the All Command Working Level Conference at Sacramento. Nor was it the last such experience, as future subteams would find as they interviewed Air Force people at all levels of COTS acquisition activity. Terminology would prove to be a major and continuing stumbling block.

Heart of the Matter. The real work of the group began with Rich Bleau's presentation on COTS supportability challenges. Emphasizing that he was delivering his own perspective, Bleau challenged participants to agree or disagree freely with any viewpoint he or others expressed. His only requirement would be a group consensus on the nature and scope of the tasks at hand.

Such open discussions led to formulation of what the group saw as the pressing problems or concerns associated with COTS acquisition logistics:

(1) Proliferation of support methods.

(2) Decreasing availability of support funding.

(3) Lack of universal definitions among the government and contractors.

(4) Lack of bidders, or high bids, due to inadequate requirements statements.

(5) Poor responsibility assignment for interface items connecting COTS.

(6) System life cycles longer than Contractor Logistics Support (CLS) contracts.

(7) A developmental mindset among acquisition personnel. (7)

At the same time, several questions were presented which would form the basis for data-gathering requirements of future subteams:

(1) What should the spares policy on stock, store, and issue for COTS items be?

(2) Are the same tools and solutions for COTS needed as for developed systems?

(3) How should long-term supportability for COTS be managed? Should there be a periodic review and assessment?

(4) Should a "COTS Center-of-Excellence" be established?

Wrap-up. To facilitate the next phase, that of data gathering, three subteams were formed. These teams would examine inputs to COTS supportability from three viewpoints:

- Acquisition: team chief Harry Williams, HQ AFSC/ENLP.
- Industry: team chief Robert Fuller, HQ ESD/PLLM.
- Users/supporters: team chief Mark Hollobaugh, HQ ALD/LSG (eventually replaced by D. L. Rupper, HQ AFCC/LGLR).

These teams were to develop questionnaires to be answered by people working in each of the three data areas. The data-gathering effort would be sponsored by Brigadier General (now Major General) Lewis E. Curtis, Commander of ALD at that time.

Finally, the group composed a mission statement as follows:

> The Working Group will recommend for incorporation in the appropriate documentation specific policy, guidance, and procedures that ensure supportability considerations are incorporated into the selection, integration and support of commercial items.(7)

The tough part was now beginning.

Data Gathering

Funding Problems. Before the subteams could even begin their work, they encountered a significant delay: lack of adequate funding. Budgets among the commands were pressed very tightly already to support mission-critical requirements. Several members reported they would be unable to participate unless some form of central funding were made available.

Facing this problem squarely, Bleau set off to find money to get the group started. While traveling to brief the principals on progress of the group to date, he took the opportunity to also request money to send the subteams on the road. This was neither a popular nor an easy task. Nor was he ever successful at getting a central fund to finance the group's work. General Curtis funded some travelers outside ALD, but was unable to meet all shortages.

Ultimately, only AFCC, AFLC, AFSC, Air Force Space Command (AFSPACECOM), and the Strategic Air Command (SAC) were able to spare funds for the effort. (Office of the Assistant Secretary of Defense (OASD) funded a trip in September 1990 for Greg Saunders to brief the group on related efforts by other members of the defense acquisition community.) The result of this underfunding was that representatives from Hq Human Systems Division (HSD), Hq Ogden Air Logistics Center (OO-ALC), and Hq Sacramento Air Logistics Center (SM-ALC) were unable to participate in data gathering. (Bill Millard from SM-ALC was able to rejoin the group in September 1990 for analysis of the data gathered and preparation of the final report.) In fact, Hq Air Training Command (ATC), Hq Tactical Air Command (TAC), and Hq San Antonio Air Logistics Center (SA-ALC) were unable to fund any participation in the group whatsoever.

Restarting the Process. By the time the funding constraints were resolved, a great deal of time had passed; so much in fact, that Rich Bleau found it necessary to reconvene the group. This was required to refocus the efforts of the members on a common task and to integrate the inevitable new members into the group.

This meeting was held on 5-6 September 1990 and hosted by ESD/AL. Probably the most significant outcome of that meeting was adoption of the final group definition of COTS. The consensus was that the "off-the-shelf" aspect of COTS would be deleted as redundant or unnecessarily confusing. The definition of a "commercial" item would be adopted instead, as found in DFAR (DOD FAR Supplement) 211.7001, 11 July 1990. This was identical to that used in the "COTS Defined" section.

Special emphasis was then placed on the accompanying definition at DFAR 211.7001 for "minor modification." *A minor modification* to a commercial item is "one that does not alter the performance or physical characteristics of the item." (5)

The impact of that new set of definitions was significant. The group stated, in essence, that there was no such thing as "modified COTS," since any alteration of a commercial item for other than cosmetic purposes (color; enclosure within a cabinet) would force the item into the developmental arena.

This alleviated many of the difficulties experienced by AFSPACECOM when forced to freeze software baselines for any period of time. (A baseline, hardware or software, that was not allowed to "float" with the marketplace would be beyond a "minor" modification.) And it stipulated that there is a grey area between developmental acquisitions and purely commercial, the area where supportability problems most commonly occur.

Also at this meeting, Cheryl Bingaman, HQ AFCC/LGSM, presented a briefing and proposal for incorporating support of COTS items within the Standard Base Supply System. She was tasked to continue her efforts, as a major part of the final set of policy and procedure recommendations to be put forward by the group.

The subteams were now ready to begin the critical phase of the effort—data gathering—which was conducted 10-21 September 1990.

Industry. The Industry subteam was assigned to interview representative commercial users of COTS equipment to determine the methods industry uses to support commercial systems. The aim was to evaluate the incorporation of "smart" practices into Air Force programs.

The team elected to visit the following companies:

- Bank of Boston, Dorchester, Massachusetts.
- Commonwealth of Massachusetts, Boston, Massachusetts.
- First Mutual of Boston, Boston, Massachusetts.
- Kollsman, Merrimack, New Hampshire.
- Massachusetts Institute of Technology, Cambridge, Massachusetts.
- Raytheon, Lexington, Massachusetts.
- Saunders Associates, Nashua, New Hampshire. (9)

Acquirers. The Acquisition subteam was assigned to interview buying division personnel within the various implementing commands. The purpose was to develop a broad range of practices currently used in Air Force programs.

The team elected to visit the following activities:

- Aeronautical Systems Division (ASD), Wright-Patterson AFB, Ohio: AL, PK, SD, YT, YW, and YZ.

- Ballistic Missile Office (BMO), Norton AFB, California: AL, MC, MV, and TRW (a contractor).

- Computer Systems Division (CSD), Gunter AFB, Alabama: AE, AQ, and SS.

- Electronic Systems Division (ESD), Hanscom AFB, Massachusetts: AL, AV, SZ, TC, WE, and SSAI (a contractor).

- Standard Systems Center (SSC), Gunter AFB, Alabama: PK and SS.

- Sacramento Air Logistics Center (SM-ALC), McClellan AFB, California: LA, LH, MM, and TI.

- Space Systems Division (SSD), Los Angeles AFB, California: AL and SD. (10)

Users/Supporters. The User/Supporter subteam was assigned to interview using and supporting command personnel. The purpose was to identify current "smart" practices used in Air Force programs to support fielded systems.

The team elected to visit the following activities:

- Air Force Communications Command (AFCC), Scott AFB, Illinois: DO and LG.

- Air Force Space Command (AFSPACECOM), Peterson AFB, Colorado: LK.

- Air Weather Service (AWS), Scott AFB, Illinois: PM.

- Military Airlift Command (MAC), Scott AFB, Illinois: DO, LG, and XR.

- Strategic Air Command (SAC), Offutt AFB, Nebraska: LG, SC, and XR.

- Sacramento Air Logistics Center (SM-ALC) Det 25, Peterson AFB, Colorado: CD and MM..

- Warner Robins Air Logistics Center (WR-ALC), Robins AFB, Georgia: MM. (11)

Data Consolidation

Final Meeting. The three teams took the results of their interviews to a final meeting, held 24-28 September 1990 and hosted by ESD/AL. The purpose of this meeting was:

(1) To inform each of the group members of the findings and recommendations of the subteams.

(2) To publish a draft report by each subteam.

(3) To draft a consolidated briefing to be used by Bleau to brief the command executives who had chartered and directed the efforts of the group.

Key recommendations of each subteam deserve separate coverage, since they are thought-provoking and represent a significant potential benefit to Air Force users. (NOTE: For a complete list of the 23 final recommendations made at this meeting, see page 34.)

Industry. This team found that key issues for industry buyers were "the requirements definition, market investigation, support strategy, warranty and preplanned replacement." Members felt that government acquirers should emulate industry practices regarding these issues to achieve maximum COTS support effectiveness. (9)

Specifically, the team recommended:

(1) Requirements statements should be limited to four to ten pages, concentrating on "what, where and when" rather than on "how."

(2) The requirements statement and market research should be an interactive process; i.e., for a COTS buy, needs should be readily satisfied by existing commercial items. If not, acquire by development.

(3) Support availability and commercial services should be "negotiated with the initial acquisition effort," not separately.

(4) Market investigation should include evaluation of previously-owned equipment and qualification testing of items. Qualification testing should include support capability.

(5) Replacement of COTS items should be preplanned as part of the acquisition strategy. Support for the life of the equipment should be negotiated at the time of buy.

(6) Deviations to available commercial support concepts should be negotiated and approved. (9)

Acquirers. This team determined that "cost and schedule, funding availability, and PMD (Program Management Directive) direction" were the "main drivers to using COTS products." (10)

Specifically, the team recommended:

(1) A market investigation/survey should be required for all COTS buys. Minimum user requirements should be established upfront and linked to the results of the market investigation.

(2) Requirements conveyed to contractors should be specific and baselined.

(3) All agencies should participate in source selection. The typically compressed production and deployment schedules in COTS buys, compared to developmental, increase the severity of failure to do this well. Programs should be budgeted to make this happen.

(4) Standardized methods to develop commercial data should be developed.

(5) Contractor historic reliability and maintainability (R&M) data should be evaluated. If not available, do verification testing.

(6) Maintenance contracts should be consolidated, when feasible, to achieve a system support approach.

(7) Technology refreshment/upgrade and new product announcement clauses should be included in contracts.

(8) Support over the total expected life of COTS equipment should be contracted upfront.

(9) Standard software and communications protocols should be used when possible to minimize the impact of vendor upgrades and changes.

(10) Implementation/installation training packages should be bought for items requiring user assembly, installation, or networking.

(11) Government maintainers should be trained and certified as contractor service representatives to avoid invalidating warranties and maintenance agreements.

(12) Support for integrated/embedded COTS items should reflect a total system approach; i.e., it should match the support concepts of the parent system.

(13) Provisioning and cataloging of COTS items should be simplified. (10)

Users/Supporters. This team found that commercial item support is very dependent "on application, mission requirements, and the user and supporting commands' overall maintenance philosophy. This is particularly true of integrated/embedded items." Another key finding was that support for commercial and developmental items is seldom compatible. (11)

Specifically, the team recommended:

(1) An integration contractor, responsible for total system integration and availability, should be used for highly complex systems.

(2) Testing should be done on COTS items used outside their intended environment, when unproven requirements are added, or when an item is modified.

(3) CICA (Competition in Contracting Act) restrictions should be reduced for COTS buys.

(4) Source selection of COTS items should emphasize qualitative factors.

(5) The baseline of COTS items should be frozen for a predetermined time. Changes and revisions should be integrated in blocks.

(6) Replacement, modifications and revisions, and support should be planned upfront.

(7) CLS (Contractor Logistics Support) should be acquired upfront.

(8) A simplified, standard automated system should be developed to track warranties.

(9) End item funds should be used to allow concurrent delivery of common as well as special support equipment and spares.

(10) SBSS procedures should be simplified and adapted to allow better and earlier support of COTS items. (11)

Final Recommendations

The consensus of the group was that significant work had been done to improve the supportability of COTS systems within the Air Force. All also agreed that much work remained to be done to convert team recommendations into reality.

That challenge was taken on by Rich Bleau. In October 1990, he began the conversion process with a series of briefings to the command executives responsible for formation of the group. In those briefings, he stressed that COTS support success would only be achieved through changes in several areas: support, acquisition, engineering, requirements, supply support, and mind-set. In essence, these could be cataloged as changes in policy, process, and infrastructure. (12) Since each of these recommendations is critical to an understanding of what remains to be done, each will be covered separately.

Support.

- Policy #1: Prefer contractor support, unless mission needs are not met.

- Policy #2: Apply vendor support concepts whether support is organic or contract.

Acquisition.

- Policy #3: Develop upfront support requirements, strategy, and contracting.

- Process #1: The acquisition agency should fund initial support of organically-supported items.

Engineering.

- Policy #4: Don't modify commercial items.

- Process #2: Emphasize system integration tools.

Requirements.

- Process #3: Tie the requirements process to market analysis.

- Infrastructure #1: Create market analysis functions in acquisition and program management agencies.

Supply Support.

- Process #4: Modify the cataloging process and SBSS.

Mind-set.

- Process #5: Train to change the developmental mind-set and to improve skills.

- Infrastructure #2: Create a commercial item support center of excellence until new policies and procedures are in place.

Future Activity

The conclusions Rich Bleau drew from his briefings form an ideal basis for stating where the Air Force's COTS efforts must go from here to achieve support success. Simply put, these were to create standard but flexible rules for commercial items; provide additional details for implementing the final recommendations, through a final COTS Supportability Working Group report; and develop headquarters-level detailed implementation plans

Unless each command involved in operation and maintenance of COTS equipment takes a personal responsibility to push the effort forward, it will be like so many other well-intentioned efforts. It will have had its moment in the sun and then fade away. If that happens, the needs and hopes of many users will once again be thwarted, and frustration will increase. Worse, the Air Force will be fielding systems that will fail to function at designed levels, for lack of the logistics support needed to keep them going. None of us can afford to let that happen.

Policy and procedures creation is not a solitary effort but requires the active input of everyone concerned. So, if you are responsible in any way for support of COTS equipment, take an active role in this important process. Don't rely on your local mail system to bring you all of the upcoming documents. Support Rich Bleau and his group by volunteering to assist in whatever way he needs you. Participate in an historic process. And that includes giving the group your honest, constructive disagreements. If their proposed policy won't work for you, tell them. More than that, show them a better way. As with so many other things, it's all up to you.

UPDATE

Since the report on Supporting Commercial Systems by Robert Olear was completed, some significant events have occurred:

> The Commercial Off-the-Shelf Supportability Working Group's recommendations were briefed by Richard Bleau to the commanders of AFLC and AFSC. The recommendations were accepted and several follow-on teams were developed to invoke these recommendations. One such group, the COTS Cataloging and Provisioning Group, is developing new procedures to allow COTS equipment to be accepted into the Standard Base Supply System (SBSS).

The Working Group's final report was published and distributed in July 1991. The final report details the CSWG's methodology and results of their efforts.

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Findings

Following is a list of the COTS Supportability Working Group's final recommendations, as agreed upon by all members in September 1990.

1. Indicate contractor support is preferred unless mission needs are not met.
2. Apply vendor support concepts whether support is organic or contract.
3. Don't modify commercial items.
4. Develop support requirements, life-time support strategy, and contract language for commercial items up front.
5. Link the requirements process to market analysis.
6. Emphasize the acquisition agency should fund initial support of organically supported items.
7. Modify the cataloguing process and the Standard Base Supply System for commercial items.
8. Emphasize system integration tools to meet the engineering challenge for commercial items.
9. Train to change the developmental mind-set and to improve skills.
10. Identify market analysis functions in acquisition and program management agencies.
11. Establish a commercial item support center of excellence until new policy and processes are in place.
12. Establish clear definitions.
13. Analyze and coordinate before changing support.
14. Prototype new ideas on selected programs.
15. Form a commercial item support strategy panel.
16. Select the vendor concept that meets Air Force needs.
17. Use the Standard Base Supply System for government-owned spares.
18. Use Contractor Owned and Maintained Base Supply and service contracts for contractor-owned spares.
19. Define support requirements up front.
20. Use modular design approaches with portable software.
21. Accept commercial support.
22. Focus on full-scale development support objectives in source selection.
23. Adapt industry practices.

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Robert G. Olear wrote this article while Logistics Management Specialist, Air Force Communications Command, Scott AFB, Illinois. He is presently a Program Administrator for the LCCEP Program at Randolph AFB, Texas.

Constraint Management: The Key to Accelerated Improvement

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We are living in challenging times where the rapidly changing environment demands greater organizational flexibility. Using terms like Global Reach and Global Power, the mission of the United States Air Force has evolved to focus more on responsiveness, flexibility, and mobility. Restructuring organizations and agencies has become the norm. In the Air Force we are witnessing the combination of Air Force Systems Command and Air Force Logistics Command into a new agency—the Air Force Materiel Command. As defense budgets shrink, competition for workload has become a reality. AFLC's Air Logistics Centers will no longer have a monopoly on aircraft and component repair. Rapidly changing policies contribute to the confusion—stock funding of depot reparables, unit costing, fee for services—the list could go on. Rapid change is inevitable in today's world. However, unless the changes in our systems are addressed from a total systems perspective, there is a grave danger of localized improvements that will greatly reduce readiness.

Department of Defense agencies are beginning to feel the same competitive pressures that gave rise to the quality and just-in-time movements in the private sector nearly eight years ago. Unquestionably, the rate of change calls for new ways of viewing and managing our systems. Recognition of the need for customer-focused management has resulted in a ground swell of interest in Total Quality Management.

As a result of our TQM emphasis, establishing a "process of on-going improvement" has become a standard phrase in the goals and objectives of almost every organization. In our haste to begin, we have failed to define clearly either "improvement" or "process." In the absence of a clearly defined mission and supporting performance measures, level of activity can quickly become a surrogate measure of organizational improvement— the impression seems to be "...if we are working hard and staying busy, we must be productive." The number of suggestions, number of active process action teams, or number of individuals completing TQM education are all easily measurable and may well be correlated with good management. Unfortunately, these measures lack the cause and effect relationship that would make them useful indicators of the overall quality health of the organization.

Measuring performance requires a clearly communicated concept of the goal of the organization. Each of our systems and subsystems was established with a specific goal or purpose in mind and all but the simplest organizations require a number of tasks to be performed sequentially. As a result, many organizations, functions, and levels become involved in the processes and *any one of them can limit the outcome*. Our processes can be compared to a chain, where interconnected links of various strength are combined in series. Constraints, or weakest links, of various forms are an unavoidable reality in any system and must be addressed by management. (1)

To improve the system, leaders must identify the weak link in the system and find methods to strengthen it. Otherwise the improvement will be localized and will be little more than an illusion at the system level. As an example of "mirage-improvements," where are all the man-years "saved" in process improvement? Have we reduced the number of employees? Can the time saved be used productively elsewhere? Why is it we fail to see the advertised financial impact on our budget after installing a $400,000 machine? Could it be that we are making decisions based on a system of cost justification that fails to acknowledge the difference between a weak link and a strong link in the chain? Is it possible for us to expend time, effort, and resources in strengthening the strong links?

Before embarking on a process of on-going improvement, after defining the system's goal, it is important to answer the question, "How can we tell when we've improved?" Until recently we looked at the localized performance measures for the subsystem being reviewed. Given the policy changes that allow customers to go elsewhere for service if they are not satisfied, it should be apparent that the most important measures of improvement must be those valued by the customer.

For example, what might the Wing Commander of a fighter wing expect from the yet-to-be-formed Air Force Materiel Command? Ideally, as the result of superior design and acquisition processes, the commander would never have logistics worries. High levels of quality and reliability are natural starting points on this wish list. However, if planes should need repair, they should be easily maintainable so they could be quickly restored to operational capability. The ideal from the operational commander's perspective is that aircraft would never have to return to the depot. But, if depot repair were required, the time spent in depot should be minimal. Similarly, as new technology is introduced, the modification process should be as painless as possible to minimize downtime while maximizing capability. Of course, costs for services need to be fair and competitive. Reliability, maintainability, quality, cost, responsiveness—these will be the critical measures of the future logistics success.

Given the customer-driven measures of quality which support the overall system's goal, it is crucial to understand the individual organization's role in the system. The second step is to identify appropriate performance measures which do not carry the risk of being suboptimal. For example, transportation can minimize transportation cost by waiting for full truckloads—at the expense of responsiveness to the customer. Depot maintenance workers can be highly "efficient" by producing a year's supply of an item in a single production lot—at the expense of delaying a part that is needed this week. Because of the potential distortion of priorities due to conflicting local and global goals, establishing valid measures is a critical concern. It is only after the goal has been defined and measures established that "improvement" has meaning.

In the hard sciences such as physics, "thinking" experiments are used to illustrate concepts without the need to carry out the experiment explicitly. Figure 1 is an example of a thinking experiment involving a simplified production system. The experiment will be used to illustrate a five-step process advocated by Dr Eliyahu M. Goldratt for system improvement. (2)

Work Center

	A	B	C	D	E
	5*	6	10	12	3
Units/Hour	12	10	6	5	20

*Processing time/unit (in minutes)

Figure 1.

The example presents a simplified system with five work centers dedicated to the production of a single product. The exact processing

time in minutes/unit for each work station is indicated by the numbers in the blocks. (Although variability in processing time would closer reflect reality, having perfect data with no variability is a best case situation.) The system operates a single eight-hour shift, five days per week. Customer demand is for 250 units per week.

The first step in managing this system is **TO IDENTIFY THE WEAKEST LINK—THE CONSTRAINT**. In Goldratt's terms a constraint is anything that limits performance relative to the goal. In the system diagramed, the average number of units that can be produced is 10.6 across all work centers. However, due to the 12-minute/unit processing time at work center D, the maximum output of the system is only 5 units per hour or 200 during the 40-hour week. As long as the market demand is for more than 200 units per week, station D is the constraint—given that current assumptions about the system are binding.

Once the constraint is identified, Goldratt suggests the second step is to **EXPLOIT THE CONSTRAINT**. In this context, exploitation is the process of being certain that the system makes the best use of every minute of constraint time. Actions would include things like manning the constraint through breaks and lunch hours to make certain that it never falls idle during the eight-hour day. Exploiting the constraint is management's attempt to squeeze every drop of capacity out of the current resources without changing the system.

In the logistics arena we often do a superb job of exploiting physical constraints such as materiel, manpower, or facility limits. In contrast, we often feel helpless in addressing the most significant limitation to our effectiveness—our policies. In this example the real constraint in the system is not work center D; instead, it is the policy that limits the work center to only 40 hours per week. In this case an extra two hours per day at the constraint would allow the work center to fully meet expected demand.

The third step in the process of on-going improvement is a logical extension of the first two. Once the constraint has been identified and exploited, **ALL ACTIVITIES SHOULD BE SUBORDINATED TO THE CONSTRAINT**. The intent of the subordination step is to use every possible resource to assist the constraint to accomplish the mission. Of all the steps, subordination is one of the most difficult to accomplish in a military setting. It may be that supply would be required to deliver materials directly to the work center (it's not our policy), or that part of the processing should be transferred to another work area to offload the constraint (it's not my job). One other example of subordination relates to the utilization of other resources. While work station A has the capability of producing 12 units per hour, the system can process only 5 units per hour. Requiring work station A to maintain 100% utilization would do nothing but increase inventory in the system since the work-in-process would increase at the rate of seven units per hour. The worker at work center A would oppose change due to the potential for negative impact of performance measures related to productivity.

However, instead of focusing on the suboptimal localized measure of utilization of a single resource, the supervisor of work center A should be measured on the basis of output required to support the maximum system output and no more. For work center A this would translate to a 41.6% utilization (units needed to support system/capacity = 5/12). If all work centers were subordinated by pacing operations off the requirements of the constraint, the overall system utilization would be only 60%. However, with unlimited raw material input and unlimited storage space, the utilization of the system could be raised to 85%. Any manager reporting a 60% utilization would risk criticism, *regardless of the fact that the two systems will produce identical output of 5 units per hour.*

The logistics implications are substantial since a policy of 100% utilization of all depot resources has been suggested for DOD depots. The inventory investment required to support high utilization would make DOD depots less competitive in the future.

After subordination of non-constraints, the next step in developing a process of on-going improvement is to **ELEVATE THE CONSTRAINT**. It is only at this point that management begins to examine ways to break the constraint. In an environment of abundant resources, it is tempting to go directly from constraint identification to the elevation process. It is surprising how many constraints can be broken without spending money by changing policies.

If in the elevation step the constraint is broken, then a new constraint will quickly arise. In the example system, if we were to allow the constraint resource to work an additional two hours of overtime per day, work center D would be able to supply the entire weekly demand (5 units/hour x 50 hours = 250 units). However, work center C would become a limiting factor for the system since it could produce only 240 units during the week. At this point the process starts over with the constraint identification process.

The final step of this five-step process provides the key to the *on-going* part of the process of on-going improvement. It is critical to be able to "overcome success" and avoid the tendency of resting on yesterday's laurels. **DON'T ALLOW INERTIA TO BECOME A SYSTEM CONSTRAINT.** Quality is a journey, not a destination.

The five steps outlined provide a common sense approach to managing systems. However, unless the goals are clearly defined and supported by global performance measures, it is likely that the improvement process will come into direct conflict with the measurement systems.

The five-step process was developed by Dr Goldratt and makes up only a small part of a body of knowledge known generally as the "Theory of Constraints." His approach addresses organizational improvement from a systems perspective and presents specific techniques to identify core problems and develop and implement simple, practical solutions.

In recent years Goldratt and his associates have focused education efforts on techniques required to place organizations on a process of on-going improvement. The five-step process can be used to provide a rational focus for TQM efforts. The extent that managers focus improvement efforts on system constraints ultimately determines the degree of system improvement. Focused improvement is in sharp contrast to the "improve- everything" mentality. The approach can be compared to the difference between laser-guided munitions and carpet bombing. Targeting makes the difference!

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We will resume publication of the "Career and Personnel Information" and "Current Research " departments in the Winter Issue.

We will publish four articles in the next few issues of the Journal which discuss World War II, the Korean War, the Vietnam War, and the Persian Gulf War. The author provides some excellent insights and analyses of these wars which will greatly contribute to the world of logistics history.

History of US Military Logistics—

World War II

Captain Jack E. King, Jr., USAF

As we observe the 50th Anniversary of the Pearl Harbor bombing this month, we need to reflect on the significance of World War II doctrine and how it changed our logistics thinking forever. This article discusses events before World War II, details logistics planning and manpower and equipment during World War II, and summarizes lessons learned from the war.

Part I

Introduction

This article, first in a four-part series, elaborates on the history of military logistics as an element of military affairs not yet mastered. Indeed, General Dwight Eisenhower reminded the world that "battles, campaigns, and even wars have been won or lost primarily because of logistics." (10:33)

For the purpose of this article series, although many definitions and arguments exist, *military logistics* will be defined as "that system established to create and sustain military capability." (8:v) Because of the types of problems encountered by today's military leaders, a look into the history of military logistics can prove quite beneficial. General Douglas MacArthur had this to say about the appropriateness of an in-depth historical analysis:

> More than most professions, the military is forced to depend on intelligent interpretation of the past for signposts charting the future.... The facts derived from historical analysis, [the soldier] applies to conditions of the present and the proximate future, thus developing synthesis of appropriate method, organization and doctrine.(10:1)

The past fifty years offers much insight into the ability, or the lack thereof, of the United States Armed Forces to learn from past mistakes.

World War II

The demobilization effort after World War I was extensive and, by the 1930s, many Americans, including the President and the Congress, believed war was unlikely for the US. The country's defense posture slid into serious jeopardy. During the 1930s, prior to World War II, the structure of the military was small, training and training materials were inadequate, and proper funding was out of the question. Why? World War I, the war that "made the world safe for democracy" (2:146;5:281;8:1), had been fought and won.

Because the US (the Allies) fought to make the world safe for democracy, then certainly many believed the US must now be safe. After all, given transoceanic capability of that period, the Atlantic required 7 days journey while the Pacific required as much as 21 days to cross safely. No aerial threat existed. The first solo transoceanic flight was not until 1927. Neighboring Canada posed no threat to the US (although Canada was considered an enemy in the war of 1812). Since the battle for the Alamo, while Texas was a budding nation, Mexico posed no real threat to the US. The mind-set in America became one of isolationism. Secure between two broad oceans (the Atlantic and the Pacific), comfortably situated on a huge continent rich in open space and seemingly unlimited resources, and relatively free from any external threat, the United States turned its attention to internal development. Americans in the 1920s enjoyed the good life—riding a roller coaster of sorts through a decade of booms and busts. In October 1929, the Great Depression wreaked havoc throughout the world. For 10 years world economies progressively worsened—US citizens were particularly affected. Hundreds of thousands of businesses closed putting multitudes of people out of work. The unemployment rate soared, sometimes reaching as high as 65%-80% in some major cities. For example, at the height of the depression, Cincinnati, Ohio, estimated its unemployment rate at 65% while neighboring Toledo reached an astounding 80% unemployment. (7) Retaining strong convictions towards isolationism continued through the 1930s. Some of the US male populace became nomadic, riding the rail system or hitching rides from passing vehicles to "prosperous" towns. In an effort to support their families, these men would build "refugee camps" at rail marshalling yards, at major highway intersections, and under bridge overpasses. Faced with the loss of so many businesses, a poor economy, and an isolationist mind-set, Congress continued to vote for reduced military budgets and decreases in military manpower. America allowed its armed forces to decline. Weapons for training purposes were nonexistent. When weapons could be found, no ammunition was available for live firing. Men training in the US Armed Forces in 1940-41 typically had no uniforms. Broomsticks replaced rifles, telephone poles replaced artillery pieces and cannons, and trucks replaced tanks. Speaking of tanks, between 1918-1939, only 35 tanks were produced, most of which were one-of-a-kind. (8:65) Furthermore, Congress refused to allow the US to actively participate in the League of Nations—a vision originating in the mind of President Woodrow Wilson.

Surprises. Challenges to isolationist convictions were on the horizon. It took Italy's invasion of Ethiopia and alignment with Germany, the subsequent German invasion of France, and the surrender of France to Germany in the Compiegne Forest between 10-21 June 1940 to persuade the White House to

seriously consider the posture of American military strength. Germany's "blitzkrieg" (mobile war) had proven its uncommon proficiencies in the air, on the land, and on the seas. By that time, most of Europe was under Germany's control. Japan, in the 1930s, was also on the rampage in the Pacific basin and Asia. Japan, through a mutual agreement with the government of China, was to "protect" Japanese businesses along the Manchurian Railway. Young Japanese officers, with their eyes on the spoils of China, felt Japan deserved a better place in the world. Because Japan was in urgent need of more space and more resources, little opposition was levied by the official Japanese government—Manchuria soon fell under the control of Tokyo.

World War II was active in Europe and Japan was belligerent in Asia. Nevertheless, the attack on Pearl Harbor by the Japanese on 7 December 1941—the impetus of US involvement in World War II—came as a surprise. Isolationism was deeply rooted, military budgets were low, party politics were high, and planning and preparation for US involvement was inadequate. Americans simply were not ready! The next day President Roosevelt went to Capitol Hill (Washington DC) and addressed a joint session of Congress. The President spoke with deep emotion these words which resolved the great debate on US participation in World War II:

> Yesterday, December 7, 1941—a date which will live in infamy—the United States of America was suddenly and deliberately attacked by naval and air forces of the Empire of Japan. . . .With confidence in our armed forces—with the unbounding determination of our people—we will gain the inevitable triumph—so help us God.
>
> I ask that the Congress declare that since the unprovoked and dastardly attack by Japan on Sunday, December 7, 1941, a state of war has existed between the United States and the Japanese Empire. (9:27-29)

Logistics Planning. Although turmoil erupted continuously throughout the world and skirmishes abounded between neighboring countries, the US did little more than to say "You shouldn't be doing this or that." For example, no embargoes were placed against Italy after its invasion of Ethiopia, Japan after its invasion of Manchuria, or Germany after its invasion of Czechoslovakia and Poland. In fact, the US continued to export petroleum products, steel, and agricultural goods, among other exports, to these countries subsequent to their aggressive acts.

Other countries, particularly those in fear of similar aggression, requested and received US support. With help from an upswing economy, due in large part to the passage of the Lend-Lease Act on 8 March 1941, America immediately began rebuilding its military strengths. This act stated that the President might ". . . sell, transfer title to, exchange, lease, lend, or otherwise dispose of any defense article to any country whose defense the president deemed vital to the defense of the [US]." (4:443)

The Lend-Lease Act, devised to overcome the Neutrality Acts of the 1930s and the subsequent Cash and Carry amendments which followed, was a measure to aid US Allies. The US ultimately became the "arsenal of democracy" (9) supplying the free world in all its battles against the Axis powers of Europe and the Japanese forces in the Pacific (Table 1). Much good came of Lend-Lease participation. To begin, all products were built to US specifications and standards. Although the US was not actively involved from the onset of the war, this measure later ensured total interoperability thereby reducing the complexity of nonstandard logistics requirements (for example, metric versus standard measurements). With US participation in the war, the prior shipments of Lend-Lease goods also served to overcome potential lead times—the US had only to increase production, not initiate production. Finally, under Reverse Lend-Lease, an exchange capability existed between the US and its Allies. The US could accept help from its Allies without payment.

Lend-Lease Aid to Allied Nations

Nation:	*Aid (in billions)*
Great Britain empire (included Canada, New Zealand, and Australia)	$31.6
Union of Soviet Socialist Republics	11.0
France	3.3
China	1.6
Others	.5
Commodity:	
Aircraft Parts	$8.2
Combat Vehicles/Parts	3.9
Trucks/Parts	2.5
Weapons/Parts	3.0
Ammunition	1.5
Non-military Aid (included clothing, chemicals, ships, tools, and food)	28.9

Source: (7)

Table 1.

Manpower and Equipment. Logisticians soon became obsessed; only one thing was on their minds. Do what had to be done to get the right things in the right quantity to the right place at the right time in the right condition. Quite a formidable task considering the complexity of a multi-theater war. World War II records indicate that 67 pounds of supplies were needed for every man every day. (For a 12-million man American force, that equates to more than 400,000 tons of supplies to be moved daily to supply only US forces. Additional needs existed for the Allies.) To further complicate matters, those 12 million Americans were spread throughout 11 active fronts (Table 2).

Military Manpower in World War II

	US Army	*US Navy*	*US Marines*	*Total*
1939	189,839	125,202	19,432	334,473
1941	1,462,315	284,427	54,359	1,801,101
1945	8,267,958	3,380,817	474,680	12,123,455

Source: (8:54)

Table 2.

Certainly, the ingenuity and selfless devotion of thousands of officers and men in the service organizations accomplished gigantic logistics achievements in light of poor advanced planning and foresight. (6:159)

Lessons Learned. Under the direction of President Roosevelt, an industrial revolution of sorts led to a boom in America's economy and, after time, produced an adequate amount of military equipment in support of the war effort. World War II was a war of "mechanized mass." (7) Annual production rates exceeded 50,000 aircraft, 20,000 tanks, 80,000 artillery pieces, and 500,000 wheeled vehicles during the war. (13:2) By war's end, the US inventory consisted of approximately 88,000 tanks, 2.5 million wheeled vehicles, 300,000 aircraft, and 6,000 ships. (7) Problems with the standardization of production arose, but just over the horizon loomed a much larger problem—manpower

(too much in the wrong place at the wrong time). Conscription drained the country of the majority of the prime male population. Many, many men were ordered overseas before adequate equipment was in place for their subsequent usage. Not enough trained men were left behind in this country to continue smooth industrial-based operations. Poor planning almost proved disastrous as the need for logistics planners, along with their proper involvement in military planning, was not generally recognized. Logisticians were merely expected to do whatever it was "operational" planners expected them to do. (1) Another lesson to be learned. But, was it learned?

General MacArthur's stature and the US Navy's suspicions of him led to a division of responsibility in the Pacific Theater rather than a single unified command structure. (12:144-146) In his Southwest Pacific Command, MacArthur surrounded himself with a staff of trust-worthies known as the "Bataan Gang" and kept his theater headquarters far from the front. (12:146) MacArthur's first air commander, Lieutenant General George Brett, was ineffective, at best, and relieved. His replacement, Major General George Kenney, successfully integrated airpower into the campaign. With forcefulness and exceptional abilities, General Kenney was trusted by MacArthur to run the air campaign as he saw fit. (12:226-227) In fact, General Kenney deserves much of the credit for MacArthur's successful air campaign during the war. The Korean War, as shall later be pointed out, highlighted the basic flaws of MacArthur's command structure.

The magnitude of World War II was such that a tremendous impact was continually placed upon the world of logistics. Forty-five militarily active countries participated (34 Allied, 11 Axis). Distribution networks were paramount to success. Spares, repair parts, food, ammunition, and medicines, among a multitude of other goods, required transportation to and from each front. The means of transportation, in turn, required its own cadre of logistics support—spares, petroleum, oil and lubricants (POL), manpower, training, etc. Casualties were high—55 million people were killed worldwide. Of those, 39 million were civilians. Twenty million casualties were experienced by the Soviet Union. Graves registration; burials; and, in many cases, transport of US fatalities back to the US placed a tremendous strain on an already burdened logistics system. Military wounded in all countries totaled more than 25 million. Hospitals had to be built, staffed, and maintained. Supplies and equipment required continual replenishment. New recruits replaced those wounded or killed in action. Each required training, clothing, weaponry, and transport to their assignment. More than $1.5 trillion ($13.5 trillion in 1988 US dollars) was attributable to war costs. Reconstruction costs were not considered in this amount.

Demobilization created more problems. "Mom-ism"—a phenomenon of unrelenting political pressure requiring the immediate release of troops for return to moms, wives, sisters, and girlfriends back at home in the US—created havoc. Air and sea transport became a major hindrance. As a result, the return of service personnel became a priority mission for 550 ships. (8:145) Because the military was demobilized as individuals rather than as units, a disintegration of units, as masses of men departed, led to an almost overnight collapse of mission capability. Experienced troops were allowed, by virtue of a point system, to participate in the mass exodus first. Each person in uniform was entitled to a point summation, known as the Adjusted Service Rating, based on a number of factors including time in service, time overseas, combat service, and parenthood. (8:145) Those with the highest points, namely the most experienced, were theoretically scheduled to return home first. Hence, very little capability remained. No one was left to perform maintenance tasks or to prepare and ship supplies and equipment back to the US. In many instances, because units were conscripted together, whole units would pack up and depart at the same time. What few personnel were left behind were inexperienced—they did not know what to do. Within a period of 12 months, in effect, the military fell from 12 million servicemen and women to less than 3 million personnel. (3:35;11) A lot of these same kinds of things can and should be said about subsequent confrontations.

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Candid Voices

Do you have some candid opinions or ideas you'd like to share with other readers? If so, this department gives you the opportunity to express yourself freely and candidly with the goal of stirring up some new thinking among our logisticians.

Closet Computer Users?

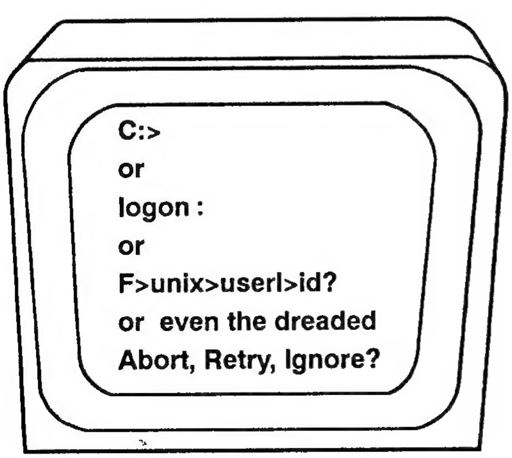
Lieutenant Colonel Walter B. Campbell III, USAF, Retired

How many of you out there remember the comic strip *Bloom County* by Berkeley Breathed? In that strip was a character with a truly awesome closet—Binkley's Anxiety Closet. Poorly imprisoned within Binkley's closet were all the things he feared most in the world. Frequently the objects of Binkley's dread would escape to bedevil him with shadows of his innermost fears. As you might imagine, entering that closet wasn't something that Binkley chose to do lightly.

To a great many people in the world, a computer embodies all that's frightening about Binkley's closet. The computer sits there, menacingly, ominously silent, waiting for an unsuspecting person to turn it on and unleash its horrible wrath. While this may sound exaggerated or preposterous, to a large number of my acquaintances and students over the years it has been an unfortunate truth. Their apprehension, rooted in a natural fear of the unknown, is very real and can be one of the biggest stumbling blocks to "computer literacy."[1]

Why should we be concerned about this phenomenon? Why waste the space and time on it in this journal? Simply put, there is virtually no facet of our professional lives (and few of our personal ones) that is not touched, often in very significant ways, by computers and computer products. From the pay statement at the end of the month, to the personnel record that forms the basis for our promotions, we are dependent on computers and their output for an incredible number of things essential to our day-to-day existence. Is there anything that can be done to make computer use less frightening? Can we lessen the anxiety and thereby improve the computer's usefulness to everyone? Yes. How? Well, like most things it begins at the beginning.[2]

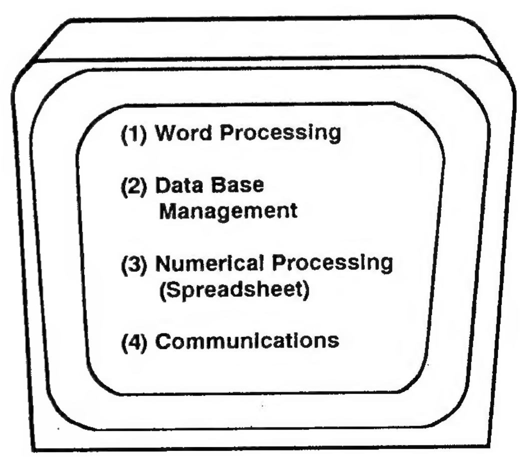
When we first turn on the overwhelming majority of computers in the workplace or home today, we are greeted with some variation of the following:



For most of us, from this moment on, the computer is in control. We are reacting and not acting, and in this game we're at a definite disadvantage. The rules to the game are built into the computer, but we have to invest many hours of effort to "break the code." Even then the knowledge can be fleeting if not repeatedly reinforced with use. The reason for this loss of control and the difficulty we face in mastering the machine lies in the way it interacts with us—the human/machine interface.[3]

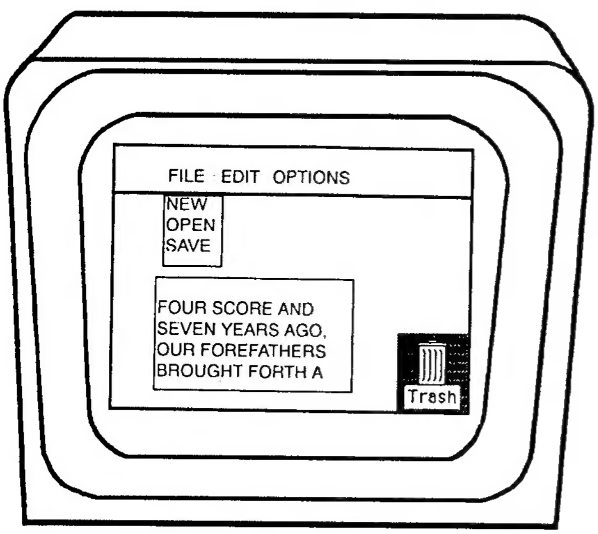
The science of determining the way machines interact with humans, Human Interface Design, has really only come into its own since the late 1960s. Computer interfaces designed to be easy and intuitive for people to use got their start with such pioneers as the people at the Xerox Palo Alto Research Center (PARC). The Xerox PARC group reasoned that, in order to make computers easier to use, they should incorporate as many common, everyday symbols into the interface as possible to lesson the shock and anxiety (remember Binkley's Closet) to the user and reduce reliance on rote memorization of commands and procedures. This was the dawn of what has come to be known as the graphical user interface (GUI). Thus the role of a "proper" GUI today is to maximize the use of common and easily understood symbols and minimize reliance on cryptic commands and constant reference to manuals.[4]

The most common interface types today[5] are command line, menu, and graphic. Each has pluses and minuses associated with its use, places differing demands on the hardware, and presents a different "face" to the user. The examples listed (C:>, logon:, etc.) are of the command line type. This type of interface works by providing one line prompts to the user (the C:>) and waiting for a command (hence the name) from the user to process. This type of interface is fast and can be supported on even the most minimal of hardware. The chief disadvantage is it provides virtually no help to the user and relies on a great deal of rote memorization. Menu-based interfaces involve a series of menus:



and allow execution of programs by selection of the menu items, usually via single keystroke commands. (For example, from the menu shown you could run your word processing program by pressing the "1" key.) These interfaces are significantly easier to use and provide greater feedback to the user. They require only nominally more hardware support than the command line interface and minimize the reliance on memorization for the user to become functional with the system. Graphic interfaces rely on the extensive use of pictures to represent common, everyday items or procedures with which users are familiar. This enables them to more intuitively grasp the system and its use.

Such graphic representations, or icons, can take advantage of the "one picture is worth a thousand words" principle to simplify the interface and interaction with the user. An example of this is the use by Apple Computer, Inc. and Hewlett-Packard using a trash can or wastebasket icon in their interfaces to represent the method of throwing away or deleting files from the system. Other common facets of GUIs are a menu "bar" or area on the screen with pull- or pop-down menus containing lists of actions; icons representing floppy or hard disk drives, files, and applications; and alternative input devices, such as a "mouse" or light pen, to facilitate the selection and manipulation of icons and menus. The GUI interface, however, places a much larger demand on the underlying hardware because of its reliance on graphics. Graphic manipulation on a computer is difficult and time consuming. For GUIs to be as responsive to the user as the command- or menu-based systems, the hardware must be extremely fast. Also, since graphics files are larger on average than text-based files, large amounts of available storage (memory and disk) are a must.



What do we expect to gain from all this emphasis on improving the man-machine interface. Chiefly, reduction in the length of the learning curve. We'd like to be able (call it the mission of the interface designer) to produce applications that are intuitive to use, require little or no preparation on the part of the new user, and can be easily run by the novice from the first moment of use. By taking advantage of the interface options already mentioned, using some knowledge about how people think and interact with the world around them, and by taking maximum advantage of the learning that people have done and continue to do every day, we can dramatically improve everyone's ability to learn and use computers.[6]

We'd like to do all this, of course, without impairing the strength and capability of programs, slowing their operating speed, or increasing their size. Until recently, however, it has been very difficult to give computer users an intuitive interface and preserve the speed and power they are used to. Because of limitations in the hardware (microprocessor speed, size and speed of storage media, screen quality or resolution, and graphics capability), companies were left with a "Hobson's choice" of increasing program responsiveness and power at the expense of minimizing the use of graphics, icons, and other easy-to-identify-and-use interface metaphors. As a result, users could have speed and power or ease of use but not both. However, this has changed dramatically in the last two years.

The advent of low cost Macintosh computers capable of sharing data and even software with IBM-compatible machines, the release of Windows 3.0 by Microsoft Corp., the development and marketing of the GEM and similar operating systems, and the widespread availability of reasonably priced and powerful computers based on the INTEL 80386 family of microprocessors have made the GUI world accessible to virtually everyone interested in using a personal computer. Given the ready accessibility (via Air Force Infrastructure Support contracts such as Desktop III and Desktop IV, General Services Administration (GSA) schedule, and local purchase options) of hardware and software that support the use of advanced user interfaces, it makes eminently good sense for us (the USAF decision makers) to take advantage of this opportunity and ensure we fully empower our users. Therefore, when you consider future purchases of computers, from portable to mainframe systems, carefully review the options and insist on systems that can provide the flexibility and capability needed to maximize the productivity of all current and future computer users.

Notes:

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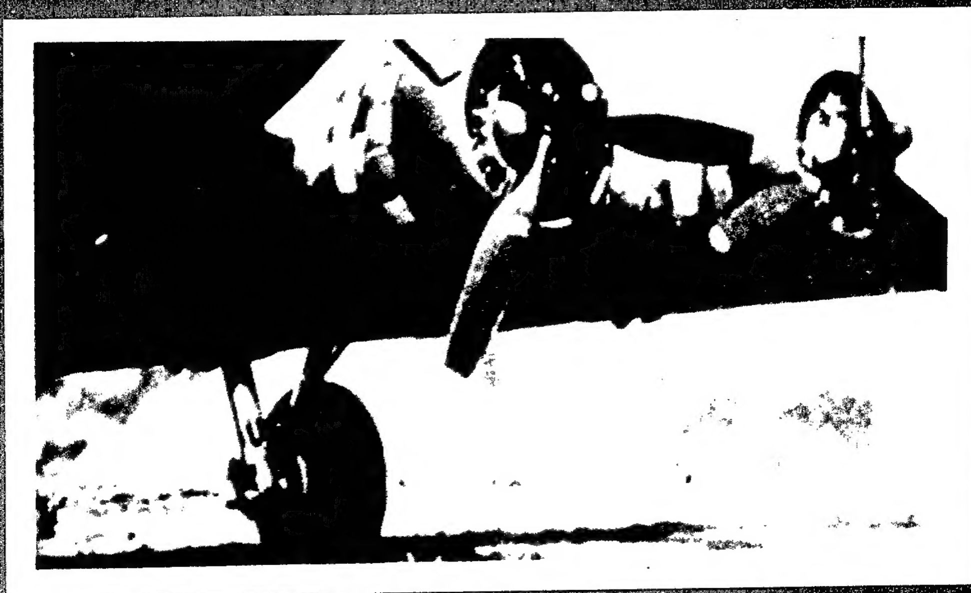
[4]Lu, p. 251.
[5]Anderson and Sullivan, *World of Computing* (Houghton Mifflin Co., 1988), pp. 120-133.
[6]White, pp. 151-170.

(Note: The company names and products mentioned in this article are used only as examples and do not imply endorsement by the Air Force in any way.)

Apple Computer Inc.'s Macintosh, Sun Micro Systems SPARC-station, and a few others have offered easy to use and powerful systems for several years, but at three to ten times the cost of comparable, non-graphic systems. The high cost of these systems, coupled with the fact that much of the software was incompatible with industry standard versions, put these systems out of the reach of most personal computer users.

Remembering...
50 years ago...
and World War II...



Hickam Field: 7 December 1941.

(See pages 37-39)